Data Summary Report for IHSS Group NE-1

IHSS NE-142.1 – Pond A-1
IHSS NE-142.2 – Pond A-2
IHSS NE-142.3 – Pond A-3
IHSS NE-142.4 – Pond A-4
IHSS NE-142.12 – Pond A-5
IHSS NE-142.8 – Pond B-4
IHSS NE-142.9 – Pond B-5
IHSS SE-142.11 – Pond C-2

Approval received from the U.S. Environmental Protection Agency
( )
Approval letter contained in the Administrative Record

June 2005

1/262

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ENCLOSURE

Compact Disc Containing Standardized Real and QC Data

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ACRONYMS

AEU	Aqautic Exposure Unit
AL	action level
AOI	analyte of interest
AR	Administrative Record
ASD	Analytical Services Division
bgs	below ground surface
BZ	Buffer Zone
CAS	Chemical Abstracts Service
CD	compact disc
CDPHE	Colorado Department of Public Health and Environment
CERCLA	Comprehensive Environmental Response, Compensation, and Liability Act
CLP	Contract Laboratory Program
COC	contaminant of concern
CRA	Comprehensive Risk Assessment
CSU	Colorado State University
dpm/g	disintegrations per minute per gram
dpm/L	disintegrations per minute per liter
DOE	U.S. Department of Energy
DQA	Data Quality Assessment
DQO	data quality objective
ECOPC	ecological contaminant of potential concern
EP	Extraction Procedure
EPA	U.S. Environmental Protection Agency
EPC	exposure point concentration
ER	Environmental Restoration
ESL	ecological screening level
EU	Exposure Unit
ft	foot or feet
ft^2	square feet
FY	Fiscal Year
HEC	Hydraulic Engineering Center
HQ	hazard quotient
HRR	Historical Release Report
IA	Industrial Area
IABZSAP	Industrial Area and Buffer Zone Sampling and Analysis Plan
IHSS	Individual Hazardous Substance Site
IM/IRA	Interim Measure/Interim Remedial Action
ISOCS	In-Situ Counting System
K-H	Kaiser-Hill Company, L.L.C.
LCS	laboratory control sample
µCi	microcurie
µg/L	micrograms per liter (may be found as ug/L)
µg/kg	micrograms per kilogram (may be found as ug/kg)

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MDC	maximum detected concentration
MDL	method detection limit
mg/kg	milligrams per kilogram
mg/L	milligrams per liter
MS	matrix spike
MSD	matrix spike duplicate
NA	not applicable
NFAA	No Further Accelerated Action
NW AEU	North Walnut Creek Aquatic Exposure Unit
OU	Operable Unit
PAC	Potential Area of Concern
PAH	polycyclic aromatic hydrocarbon
PARCCS	precision, accuracy, representativeness, completeness, comparability, and sensitivity
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
pCi/L	picocuries per liter
PCOC	potential contaminant of concern
pg/g	picograms per gram
QA	quality assurance
QC	quality control
RCRA	Resource Conservation and Recovery Act
RFCA	Rocky Flats Cleanup Agreement
RFETS or Site	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
RIN	report identification number
RL	reporting limit
RPD	relative percent difference
SAP	Sampling and Analysis Plan
SEP	Solar Evaporation Pond
SID	South Interceptor Ditch
SOR	sum of ratios
SOW	Statement of Work
SSRS	Subsurface Soil Risk Screen
SVOC	semivolatile organic compound
SW AEU	South Walnut Creek Aquatic Exposure Unit
SWD	Soil Water Database
UCL	upper confidence limit
USDA	U.S. Department of Agriculture
UTL	upper tolerance limit
V&V	verification and validation
VOC	volatile organic compound
WC AEU	Woman Creek Aquatic Exposure Unit
WEPP	Water Erosion Prediction Project
WRW	wildlife refuge worker

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Approval of this Data Summary Report constitutes regulatory agency concurrence that the IHSSs included in this report are NFAA Sites. This information and NFAA determination will be documented in the Fiscal Year (FY) 2005 (05) Historical Release Report (HRR).

2.0 SITE CHARACTERIZATION

IHSS Group NE-1 information consists of historical knowledge (DOE 1992-2004) and sampling data. Historical information is summarized in Section 2.1. Characterization data, collected in accordance with the Phase I Resource Conservation and Recovery Act (RCRA) Facility Investigation/Remedial Investigation (RFI/RI) Work Plan for Walnut Creek Priority Drainage, Operable Unit (OU) 6 (DOE 1992), the Industrial Area (IA) and Buffer Zone (BZ) Sampling and Analysis Plan (SAP) (IABZSAP) (DOE 2004b), and CRA SAP Addendum #05-01 – Phase 2 Targeted Sampling (DOE 2004c), are presented in Section 2.2. Recent sediment data for Ponds A-1 and A-2 collected as part of the targeted CRA sampling is presented in section 2.2.

2.1 Historical Information

The following sections contain historical information on the ponds summarized from the HRR (DOE 1992-2004).

RFETS began using the ponds immediately upon opening the Plant. The A-, B-, and C-series ponds were designed and constructed to provide residence time and holding capacity for spills and sedimentation of suspended material. Some of the stream and pond sediments have become contaminated due to releases from industrial processes. Potential contaminants of concern (PCOCs) include radionuclides, metals, pesticides, polychlorinated biphenyls (PCBs), and nitrates.

2.1.1 A-Series Ponds

The A-series ponds are located in the North Walnut Creek drainage, downstream of the 900 Area, and include Pond A-1 (IHSS NE-142.1), Pond A-2 (IHSS NE-142.2), Pond A-3 (IHSS NE-142.3), Pond A-4 (IHSS NE-142.4), and Pond A-5 (IHSS NE-142.12). The general types of materials that were directly or indirectly released to the A-series drainage (non-emergency and nonspill-related) during the history of RFETS included untreated wastewater from Building 771, cooling tower and roof drain water from Building 774, Building 774 evaporator condensate water, and footing drain flows. The Building 771 wastewater primarily consisted of decontamination laundry wastewater; however, it also contained water from the analytical laboratory, radiography operations, personnel decontamination room, and runoff. Building 771 waste discharged to a storm drain north (PAC 700-143) and west of Building 771, and flowed to the A-series drainage. In 1971, it was reported that the Building 774 evaporator condensate drain typically released 20,000 gallons of water per day at 100 disintegrations per minute per liter (dpm/L), with 5 milligrams per liter (mg/L) of nitrate.

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1.0 INTRODUCTION

This Data Summary Report summarizes characterization activities conducted at Individual Hazardous Substance Site (IHSS) Group NE-1 at the Rocky Flats Environmental Technology Site (RFETS or Site) near Golden, Colorado. Results are compared to wildlife refuge worker (WRW) action levels (ALs) described in the Rocky Flats Cleanup Agreement (RFCA) (DOE et al. 2003). Ecological risk is summarized in this report and detailed in Appendices A, B, and C. Ecological risk will be further evaluated in the ecological portion of the Sitewide Comprehensive Risk Assessment (CRA).

This IHSS Group consists of the 13 IHSSs and Potential Areas of Concern (PACs) listed in Table 1. The locations of the IHSS Group NE-1 IHSSs addressed in this report are shown on Figure 1. Sites addressed in this report are in bold in Table 1 and labeled on Figure 1. This Data Summary Report does not include information on IHSSs NE-142.5 (Pond B-1), NE-142.6 (Pond B-2), NE-142.7 (Pond B-3), and SE-142.10 (Pond C-1), or PAC NE-1404. IHSSs NE-142.5, NE-142.6, and NE-142.7 were remediated, and these activities are described in the Closeout Report for Ponds B-1, B-2, and B-3 (DOE 2005a). Pond C-1 (IHSS NE-142.10) received No Further Accelerated Action (NFAA) approval in 2004 (DOE 2004a) and PAC NW-1505 (North Firing Range) was submitted for NFAA approval in 2005 (DOE 2005b). PAC NE-1404, diesel spill at Ponds B-2 Spillway was evaluated as part of IHSS Group NE/NW (DOE 2003).

Table 1
IHSS Group NE-1 Disposition Documents

IHSS/PAC	Disposition Document
IHSS NE-142.1 – Pond A-1	**Data Summary Report for IHSS Group NE-1**
IHSS NE-142.2 – Pond A-2	**Data Summary Report for IHSS Group NE-1**
IHSS NE-142.3 – Pond A-3	**Data Summary Report for IHSS Group NE-1**
IHSS NE-142.4 – Pond A-4	**Data Summary Report for IHSS Group NE-1**
IHSS NE-142.12 – Pond A-5	**Data Summary Report for IHSS Group NE-1**
IHSS NE-142.5 – Pond B-1	Closeout Report for IHSS Group NE-1, Ponds B-1, B-2, and B-3
IHSS NE-142.6 – Pond B-2	Closeout Report for IHSS Group NE-1, Ponds B-1, B-2, and B-3
IHSS NE-142.7 – Pond B-3	Closeout Report for IHSS Group NE-1, Ponds B-1, B-2, and B-3
IHSS NE-142.8 – Pond B-4	**Data Summary Report for IHSS Group NE-1**
IHSS NE-142.9 – Pond B-5	**Data Summary Report for IHSS Group NE-1**
IHSS NE-142.10 – Pond C-1	NFAA Justification, HRR 2004
IHSS NE-142.11 – Pond C-2	**Data Summary Report for IHSS Group NE-1**
PAC NE-1404 – Diesel Spill at Pond B-2 Spillway	Data Summary Report for IHSS Group NE/NW (DOE 2003)
PAC NW-1505 – North Firing Range	Closeout Report for IHSS Group NE-1, Potential Area of Concern (PAC) NW-1505, North Firing Range (DOE 2005b)

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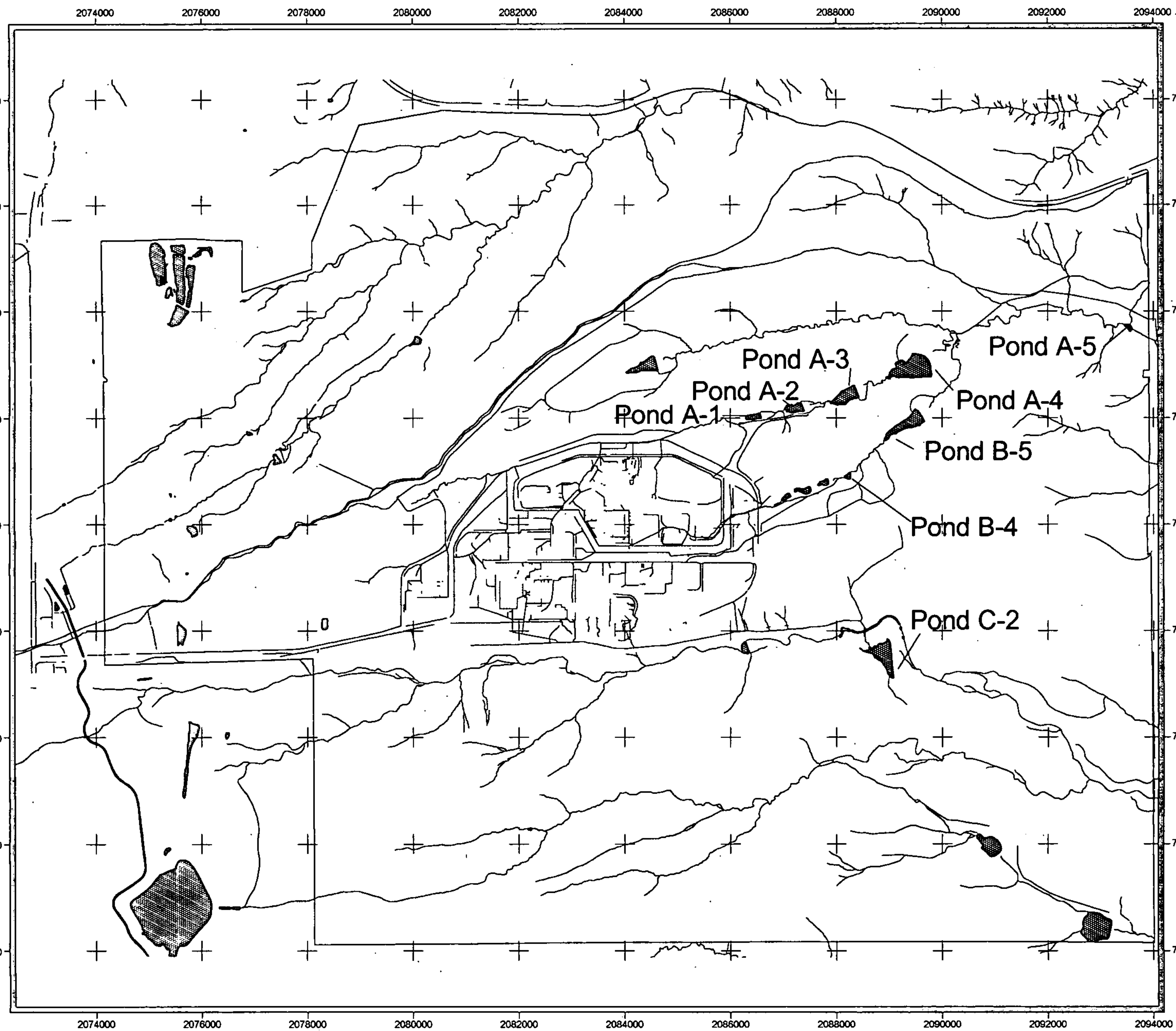

Figure 1
IHSS Group NE-1
Pond Locations

KEY

- Site Boundary
- Stream
- Pond

DRAFT

N
W E
S

2000 0 2000 Feet

Scale 1: 35000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Date: 05.23.05

RADMS

Prepared for:

KAISER•HILL
COMPANY

File: W:\Projects\FY2005\CRA\Ponds\ponds.apr

In 1973, it was estimated that 14 microcuries (μCi) of plutonium-239/240 were present in Pond A-1 sediment. In response to this problem, a series of trenches and pumps to collect contaminated groundwater and seepage was constructed between the Solar Evaporation Ponds (SEP) (PAC 000-101) and the A-series drainage. Other response actions to contamination in the A-series drainage included the removal of contamination near the Building 771 outfall (PAC 700-143), rerouting of discharges to other facilities, and elimination of flows from Building 774.

2.1.2 B-Series Ponds

The B-series ponds are located in the South Walnut Creek drainage, downstream of the 900 Area, and include Pond B-1 (IHSS NE-142.5), Pond B-2 (IHSS NE-142.6), Pond B-3 (IHSS NE-142.7), Pond B-4 (IHSS NE-142.8), and Pond B-5 (IHSS NE-142.9). PAC NE-1404, Diesel Spill at Pond B-2, was dispositioned with IHSS Group NE/NW. A sediment study conducted by Colorado State University (CSU) resulted in data that indicated radioactive contamination in sediments in the B-series drainage. Pond reconstruction activities in 1971 to 1973 caused resuspension and downstream migration of contaminated sediment. This resulted in an increase in plutonium-239/240 activity in Pond B-1 sediment from 0.085 curie in 1971 to 2.9 curies in 1973. Based on the CSU sampling, plutonium-239/240 activities in Pond B-1 sediment in June 1973 ranged from 10 to 502 picocuries per gram (pCi/g) of dry sediment.

A Rocky Flats study completed in June 1973 indicated radioactive contamination of sediments upstream from the drainage ponds. This study found an average activity of 40 disintegrations per minute per gram (dpm/g) from the "west culvert" (the culvert west of the Building 995 outfall) to the "east culvert" (the culvert immediately east of the Building 995 outfall). The area of contaminated soil/sediment was estimated to cover approximately 3,900 square feet (ft^2).

Releases to the B-series drainage included a sodium hydroxide discharge from a bulk caustic storage tank that was diverted to Pond B-1 for temporary holding; a steam condensate line break in the Building 707 area that discharged to Pond B-4 and South Walnut Creek downgradient of Pond B-4; release of approximately 155 gallons of a 25 percent solution of ethylene glycol (antifreeze); and a release of chromic acid to Pond B-3 from the Sewage Treatment Plant (Building 995) that occurred on February 22 and 23, 1989. It is believed that approximately 4.7 pounds of chromium were released to Pond B-3. The water from Pond B-3 was then sprayed on the East Spray Fields (PACs NE-216.1 and NE-216.3).

In response to the 1973 identification of plutonium-239/240 contamination in the drainage sediments, a study was conducted to ascertain the source of the plutonium-239/240 contamination present in the B-series drainage. This study indicated that approximately 88 percent of the total activity released by Building 995 was due to the release of laundry decontamination water to the sanitary sewer. After December 21, 1973, laundry water was only discharged to Pond B-2, where some of the water may have been diverted to Pond A-2. In fall and winter 1973, contaminated soil/sediment removal operations were conducted in the streambed below the Building 995 outfall. Analysis of soil/sediment samples indicated that the concentrations of leachable chromium were far below the RCRA Extraction Procedure (EP) Toxicity limits.

In the early 1980s, actions were taken at Pond B-5 to reduce the potential for off-site movement of contaminated sediments. The discharge structure for this pond was modified by adding a vertical standpipe and a perforated pipe along the bottom of the pond surrounded by granular material. Some sediment present in Pond B-5 was also removed from the drainage and deposited in the Soil Dump Area in the northeastern BZ (PAC NE-156.2) which received NFAA approval in 1999 [EPA, CDPHE 1999]). These activities helped minimize the off-site transport of contaminated sediments (DOE 1992).

In summary, based on the wastes and discharges to the B-Series Ponds, the types of contaminants detected included plutonium-239/240, americium-241, arsenic, beryllium, gamma-bhc, and methylene chloride. Pond B-1 appears to have the greatest amount of contamination, with a number of sediment sample results that exceeded the corresponding RFCA WRW ALs for plutonium-239/240 and americium-241. Several sediment samples from Ponds B-2 and B-3 also exceeded WRW ALs for plutonium-239/240 and americium-241. Historical sample results from Ponds B-4 and B-5 were less than WRW ALs. In 2005, sediment from Ponds B-1, B-2, and B-3 was excavated, and the ponds were backfilled (DOE 2005a).

2.1.3 C-Series Ponds

The C-series ponds are located in the Woman Creek Drainage, southeast of the 800 Area, and include Pond C-1 (IHSS NE-142.10) and Pond C-2 (IHSS SE-142.11). Pond C-1 was built in 1955 to provide temporary holding and monitoring of Woman Creek water and water discharged from RFETS Ponds 6, 7, and 8 (which are no longer in existence). Pond C-2 and the South Interceptor Ditch (SID) were built in 1979. The SID was built to reroute runoff from the southern portions of the RFETS main manufacturing area to Pond C-2. Water from the SID was the only input to Pond C-2, allowing Pond C-2 to serve as a surface water retention and spill control pond. Discharges from Pond C-1 are routed around Pond C-2 and back into the natural Woman Creek channel.

Potential hazardous releases into the Woman Creek drainage included water treatment plant backwash; 2,700 gallons of steam condensate from the Building 881 cooling towers; sanitary sewer overflow and discharge of untreated sanitary sewage; Building 881 cooling tower overflow/blowdown; ash from the Plant incinerator; dumping of graphite, used caustic drums, and general trash; resuspended soil and runoff from the 903 Pad area (IHSS Group 900-11); fuel/oil discharge from an overturned armored vehicle; leakage from the SID to Woman Creek; direct runoff from the East Spray Fields (PACs NE-216.1 and NE-216.3); spill of waste acid into the SID; and measurable quantities of atrazine in Pond C-2. No sediment samples collected from Pond C-1 or Pond C-2 exceeded RFCA WRW ALs. Pond C-1 received NFAA approval in 2004 (DOE 2004a). Additional accelerated actions included removal of the 903 Pad, radioactively contaminated soil under and around the 903 Pad, and radioactively contaminated soil in the Windblown Area.

2.2 Characterization Data

Analytical results for IHSS Group NE-1 sediment samples are shown on Figures 2 through 5 and summarized in Table 2. Only results greater than background means plus two standard deviations (for inorganics) or reporting limits (RLs) (for organics) are presented. Nondetected

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analytes are not presented on the figures or in the table. Data include results from recent CRA targeted sampling at the pondsin accordance with the CRA SAP Addendum #05-01 (DOE 2004a) and past OU sampling. All contaminant activities and concentrations are less than RFCA WRW ALs. Sampling locations and dates with all results less than RLs or background means plus two standard deviations are listed in Table 3.

Sediment and subsurface soil samples were collected from one location in Pond A-1 (location CS53-000) and one location in Pond A-2 (location CW54-000) as part of the CRA Targeted Sampling.

Pond A-1 sediment and soil were analyzed for radionuclides, metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PCBs, and dioxins/furans. Sediment was collected from 1.5 feet to 3.0 feet below the surface and soil was collected from 3.0 feet to 9.0 feet below the surface. The 0.0 to 1.5 foot sediment interval was not recovered. All analytical results were less than WRW soil ALs. Dioxins and furans do not have WRW ALs. Americium-241, plutonium239/240, uranium-235 and uranium-238 were detected at activities greater than background mean plus two standard deviations in sediment below 1.5 feet. Metals detected at concentrations greater than background mean plus two standard deviations in sediment included aluminum, arsenic, barium, cadmium, chromium, copper, iron, nickel, vanadium, and zinc. Metals detected at concentrations greater than background mean plus two standard deviations in soil included cadmium, cobalt, iron, manganese, nickel, uranium, and zinc. Organics detected in sediment included dioxins/furans, acetone, indeno (1,2,3-cd)pyrene, methylene chloride, and phenol. Organics detected in soil included 2-butanone, acetone, carbon disulfide, methylene chloride, toluene, and one dioxin/furan congener.

Pond A-2 sediment and soil were analyzed for radionuclides, metals, volatile organic compounds (VOCs), semivolatile organic compounds (SVOCs), PCBs, and dioxins/furans. Sediment was collected from 0.0 to 4.5 feet below the surface and soil from 4.5 feet to 8.5 feet below the surface. All analytical results were less than WRW soil ALs. Dioxins and furans do not have WRW ALs. Americium-241, plutonium239/240, and uranium-238 were detected at activities greater than background mean plus two standard deviations in sediment and in subsurface soil. Metals detected at concentrations greater than background mean plus two standard deviations in sediment included aluminum, arsenic, barium, cadmium, chromium, copper, iron, lithium, manganese, nickel, strontium, vanadium, and zinc. Metals were not detected at concentrations greater than background mean plus two standard deviations in soil. Organics detected in sediment included, 2-butanone, acetone, benzoic acid, bis(2-ethylhexyl)phthalate, methylene chloride, Aroclor-1254, and dioxins/furans Organics detected in soil included 2-butanone, acetone, bis(2-ethylhexyl)phthalate, methylene chloride, and one dioxin/furan congener.

The data, retrieved from the RFETS Soil Water Database (SWD) on March 29, 2005, are provided on the enclosed compact disc (CD). The CD contains standardized real and quality control (QC) data, including Chemical Abstracts Service (CAS) numbers, analyte names, and units.

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2.3 Sums of Ratios

RFCA sums of ratios (SORs) were calculated for the IHSS Group NE-1 sampling locations based on the characterization analytical data for the contaminants of concern (COCs). Radionuclide SOR calculations include americium-241, plutonium-239/240, uranium-234, uranium-235, and uranium-238 when results were greater than background means plus two standard deviations. Table 4 presents the radionuclide SORs. All SORs for radionuclides in surface soil (0 to 3 feet[ft]) were less than 1.

Nonradionuclide SORs, shown in Table 5, were calculated for all locations with analytical results greater than 10 percent of the WRW ALs, where aluminum, arsenic, iron, manganese, and polycyclic aromatic hydrocarbons (PAHs) are exempt from the 10 percent criterion and the calculation. At IHSS Group NE-1 chromium was greater than 10 percent of their WRW ALs at location SED61092 in Pond A-3, and antimony was greater than 10 percent of their WRW ALs at location SED61692 in Pond A-4.

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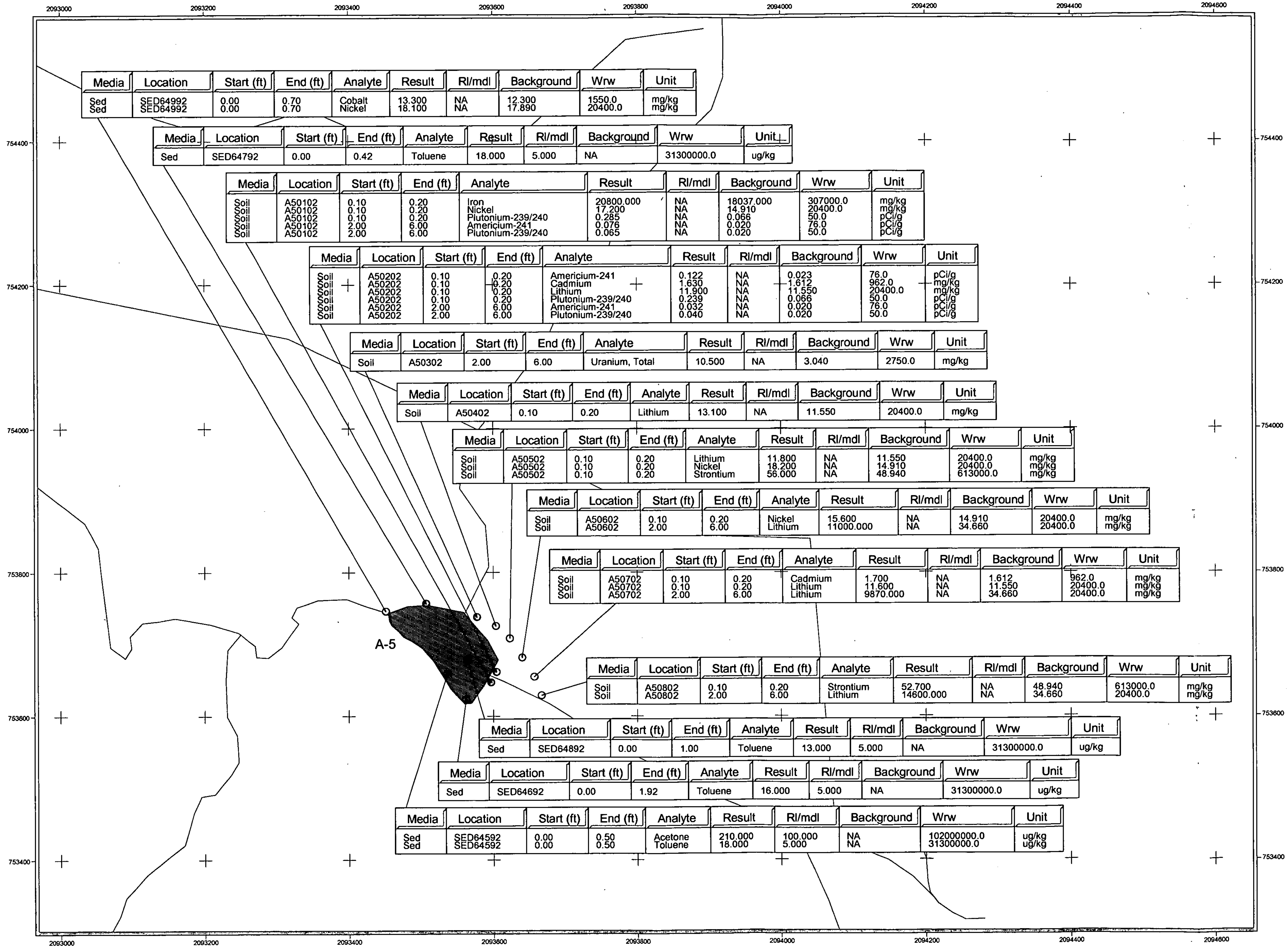
Figure 3
Pond A-5 Sediment and Soil Results Greater than Background Means Plus Two Standard Deviations or RLs/MDLs



Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64992	0.00	0.70	Cobalt	13.300	NA	12.300	1550.0	mg/kg
Sed	SED64992	0.00	0.70	Nickel	18.100	NA	17.890	20400.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64792	0.00	0.42	Toluene	18.000	5.000	NA	31300000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Soil	A50102	0.10	0.20	Iron	20800.000	NA	18037.000	307000.0	mg/kg
Soil	A50102	0.10	0.20	Nickel	17.200	NA	14.910	20400.0	mg/kg
Soil	A50102	0.10	0.20	Plutonium-239/240	0.285	NA	0.066	50.0	pCi/g
Soil	A50102	2.00	6.00	Americium-241	0.076	NA	0.020	76.0	pCi/g
Soil	A50102	2.00	6.00	Plutonium-239/240	0.065	NA	0.020	50.0	pCi/g

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Soil	A50202	0.10	0.20	Americium-241	0.122	NA	0.023	76.0	pCi/g
Soil	A50202	0.10	0.20	Cadmium	1.630	NA	1.612	962.0	mg/kg
Soil	A50202	0.10	0.20	Lithium	11.900	NA	11.550	20400.0	mg/kg
Soil	A50202	0.10	0.20	Plutonium-239/240	0.239	NA	0.066	50.0	pCi/g
Soil	A50202	2.00	6.00	Americium-241	0.032	NA	0.020	76.0	pCi/g
Soil	A50202	2.00	6.00	Plutonium-239/240	0.040	NA	0.020	50.0	pCi/g

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Soil	A50302	2.00	6.00	Uranium, Total	10.500	NA	3.040	2750.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Soil	A50402	0.10	0.20	Lithium	13.100	NA	11.550	20400.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Soil	A50502	0.10	0.20	Lithium	11.800	NA	11.550	20400.0	mg/kg
Soil	A50502	0.10	0.20	Nickel	18.200	NA	14.910	20400.0	mg/kg
Soil	A50502	0.10	0.20	Strontium	56.000	NA	48.940	613000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Soil	A50602	0.10	0.20	Nickel	15.600	NA	14.910	20400.0	mg/kg
Soil	A50602	2.00	6.00	Lithium	11000.000	NA	34.660	20400.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Soil	A50702	0.10	0.20	Cadmium	1.700	NA	1.612	962.0	mg/kg
Soil	A50702	0.10	0.20	Lithium	11.600	NA	11.550	20400.0	mg/kg
Soil	A50702	2.00	6.00	Lithium	9870.000	NA	34.660	20400.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Soil	A50802	0.10	0.20	Strontium	52.700	NA	48.940	613000.0	mg/kg
Soil	A50802	2.00	6.00	Lithium	14600.000	NA	34.660	20400.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64892	0.00	1.00	Toluene	13.000	5.000	NA	31300000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64692	0.00	1.92	Toluene	16.000	5.000	NA	31300000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64592	0.00	0.50	Acetone	210.000	100.000	NA	102000000.0	ug/kg
Sed	SED64592	0.00	0.50	Toluene	18.000	5.000	NA	31300000.0	ug/kg

KEY

- Result greater than background/RL and less than WRW AL
- Stream
- Pond

DRAFT

N
W
E
S

100 0 100 Feet

Scale = 1: 1700

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Date: 03.28.05

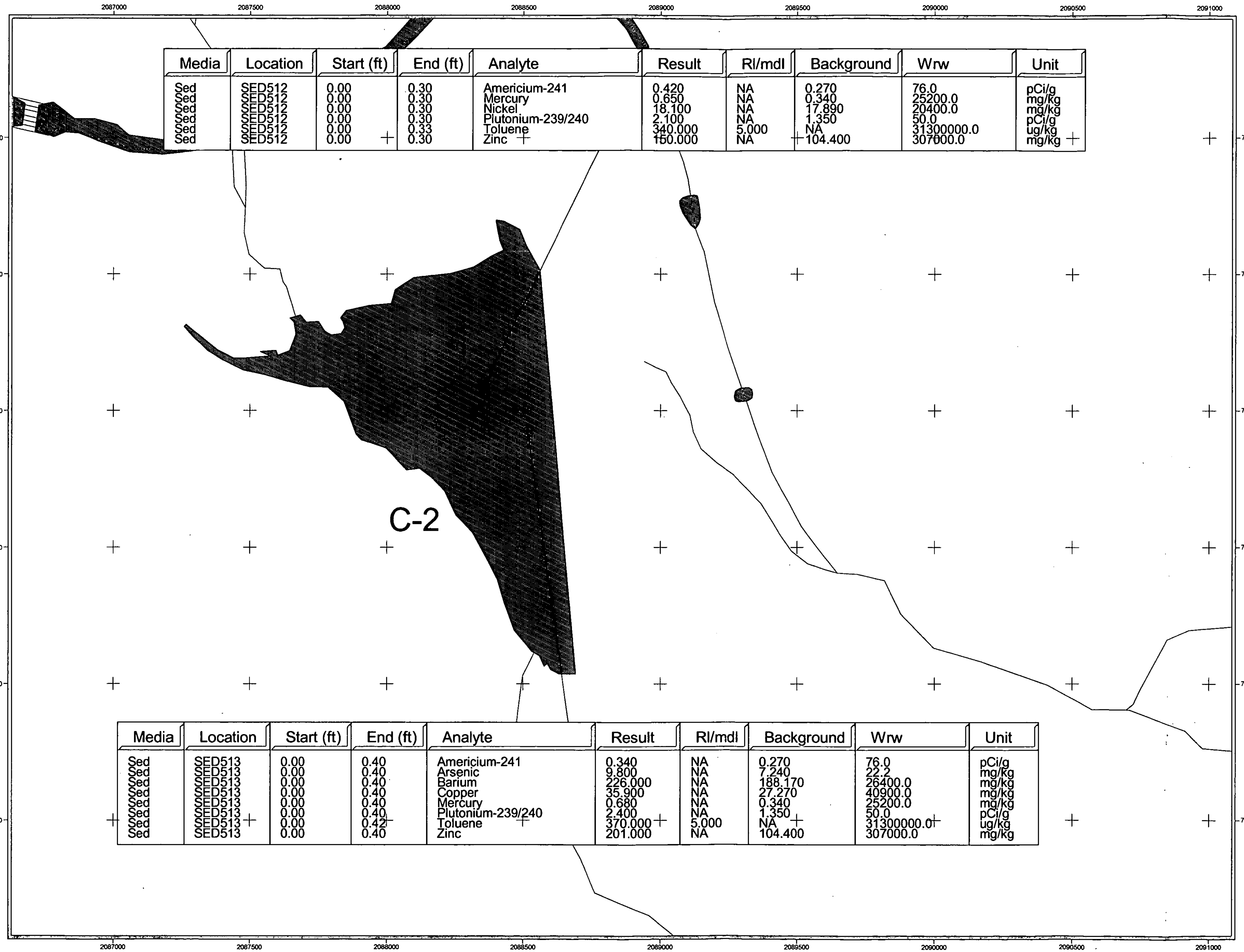
RADMS

Prepared for:

KAISER•HILL COMPANY

File: W:\Projects\FY2005\CRA\Ponds\ponds.apr

OU06-A-00061



Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED512	0.00	0.30	Americium-241	0.420	NA	0.270	76.0	pCi/g
Sed	SED512	0.00	0.30	Mercury	0.650	NA	0.340	25200.0	mg/kg
Sed	SED512	0.00	0.30	Nickel	18.100	NA	17.890	20400.0	mg/kg
Sed	SED512	0.00	0.30	Plutonium-239/240	2.100	NA	1.350	50.0	pCi/g
Sed	SED512	0.00	0.33	Toluene	340.000	5.000	NA	31300000.0	ug/kg
Sed	SED512	0.00	0.30	Zinc	150.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED513	0.00	0.40	Americium-241	0.340	NA	0.270	76.0	pCi/g
Sed	SED513	0.00	0.40	Arsenic	9.800	NA	7.240	22.2	mg/kg
Sed	SED513	0.00	0.40	Barium	226.000	NA	188.170	26400.0	mg/kg
Sed	SED513	0.00	0.40	Copper	35.900	NA	27.270	40900.0	mg/kg
Sed	SED513	0.00	0.40	Mercury	0.680	NA	0.340	25200.0	mg/kg
Sed	SED513	0.00	0.40	Plutonium-239/240	2.400	NA	1.350	50.0	pCi/g
Sed	SED513	0.00	0.42	Toluene	370.000	5.000	NA	31300000.0	ug/kg
Sed	SED513	0.00	0.40	Zinc	201.000	NA	104.400	307000.0	mg/kg

Figure 5
Pond C-2
Sediment Results Greater Than Background Means Plus Two Standard Deviations or RLs/MDLs

KEY

- Result greater than background/RL/MDL and less than WRW AL

Stream

Pond

DRAFT

N
W E
S

100 0 100 Feet

Scale = 1: 2000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Date: 03.28.05

RADMS

Prepared for:

KAISER•HILL COMPANY

File: W:\Projects\FY2005\CRA\Ponds\ponds.apr

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Table 2
IHSS Group NE-1 Soil and Sediment Results Greater Than Background Means Plus Two Standard Deviations or RLs

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
Pond A-1												
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	1234678-HpCDD	94.600	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	1234678-HPCDF	29.800	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	1234789-HpCDF	2.430	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	123478-HxCDF	3.710	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	123678-HxCDD	4.550	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	123678-HxCDF	2.500	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	123789-HxCDD	3.290	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	12378-PeCDF	1.970	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	234678-HxCDF	1.990	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	23478-PeCDF	4.290	1.840	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	2378-TCDF	6.120	0.735	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Acetone	11.000	7.200	NA	102000000.0	ug/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Aluminum	29000.000	NA	15713.070	228000.0	mg/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Americium-241	5.970	NA	0.270	76.0	pCi/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Aroclor-1260	150.000	2.200	NA	12400.0	ug/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Arsenic	7.700	NA	7.240	22.2	mg/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Barium	230.000	NA	188.170	26400.0	mg/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Cadmium	2.000	NA	1.880	962.0	mg/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Chromium	28.000	NA	23.230	268.0	mg/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Copper	43.000	NA	27.270	40900.0	mg/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Dioxin	2.780	0.735	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Indeno(1,2,3-cd)pyrene	210.000	34.000	NA	34900.0	ug/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Iron	23000.000	NA	21379.010	307000.0	mg/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Methylene chloride	3.700	1.300	NA	2530000.0	ug/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Nickel	22.000	NA	17.890	20400.0	mg/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	O8CDD	539.000	3.680	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	OCDF	40.900	3.680	NA	NA	pg/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Phenol	54.000	53.000	NA	613000000.0	ug/kg

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Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Plutonium-239/240	16.200	NA	1.350	50.0	pCi/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Uranium-235	0.352	NA	0.150	8.0	pCi/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Uranium-238	4.060	NA	3.460	351.0	pCi/g
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Vanadium	57.000	NA	46.830	7150.0	mg/kg
CS53-000	Dec-04	Sed	752020.351	2086557.935	1.5	3.0	Zinc	120.000	NA	104.400	307000.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	3.0	5.0	2-Butanone	9.800	5.600	NA	192000000.0	ug/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	3.0	5.0	Acetone	94.000	5.500	NA	102000000.0	ug/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	3.0	5.0	Cadmium	1.800	NA	1.700	962.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	3.0	5.0	Carbon Disulfide	2.500	1.100	NA	15100000.0	ug/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	3.0	5.0	Iron	85000.000	NA	41046.520	307000.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	3.0	5.0	Methylene chloride	2.300	0.950	NA	2530000.0	ug/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	3.0	5.0	O8CDD	3.790	2.800	NA	NA	pg/g
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Acetone	21.000	5.300	NA	102000000.0	ug/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Cadmium	2.300	NA	1.700	962.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Cobalt	55.000	NA	29.040	1550.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Iron	110000.000	NA	41046.520	307000.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Manganese	1400.000	NA	901.620	3480.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Methylene chloride	2.700	0.930	NA	2530000.0	ug/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Nickel	190.000	NA	62.210	20400.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Toluene	0.980	0.910	NA	31300000.0	ug/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Uranium, Total	5.700	NA	3.040	2750.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	5.0	7.0	Zinc	300.000	NA	139.100	307000.0	mg/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	7.0	9.0	Acetone	15.000	5.300	NA	102000000.0	ug/kg
CS53-000	Dec-04	Soil	752020.351	2086557.935	7.0	9.0	Methylene chloride	2.400	0.930	NA	2530000.0	ug/kg
SED60092	Jun-94	Sed	752021.870	2086548.620	0.0	0.5	Americium-241	0.906	NA	0.270	76.0	pCi/g
SED60092	Jun-94	Sed	752021.870	2086548.620	0.0	0.5	Plutonium-239/240	3.383	NA	1.350	50.0	pCi/g
SED60092	Jun-94	Sed	752021.870	2086548.620	0.0	0.5	Uranium-235	0.193	NA	0.150	8.0	pCi/g
SED60092	Jun-94	Sed	752021.870	2086548.620	0.0	0.5	Uranium-238	4.033	NA	3.460	351.0	pCi/g
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Americium-241	12.250	NA	0.270	76.0	pCi/g
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Antimony	29.600	NA	13.010	409.0	mg/kg
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Aroclor-1254	590.000	350.000	NA	12400.0	ug/kg
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Barium	193.000	NA	188.170	26400.0	mg/kg
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Cadmium	3.400	NA	1.880	962.0	mg/kg
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Copper	28.700	NA	27.270	40900.0	mg/kg

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Fluoranthene	790.000	660.000	NA	27200000.0	ug/kg
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Mercury	0.360	NA	0.340	25200.0	mg/kg
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Plutonium-239/240	35.470	NA	1.350	50.0	pCi/g
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Pyrene	710.000	660.000	NA	22100000.0	ug/kg
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Toluene	200.000	5.000	NA	31300000.0	ug/kg
SED60092	Oct-92	Sed	752021.870	2086548.620	0.0	1.5	Zinc	110.000	NA	104.400	307000.0	mg/kg
SED60392	Jun-94	Sed	752038.370	2086502.500	0.0	0.5	Americium-241	0.937	NA	0.270	76.0	pCi/g
SED60392	Jun-94	Sed	752038.370	2086502.500	0.0	0.5	Plutonium-239/240	2.429	NA	1.350	50.0	pCi/g
SED60392	Jun-94	Sed	752038.370	2086502.500	0.0	0.5	Uranium-238	3.535	NA	3.460	351.0	pCi/g
SED60392	Oct-92	Sed	752038.370	2086502.500	0.0	1.3	Americium-241	11.480	NA	0.270	76.0	pCi/g
SED60392	Oct-92	Sed	752038.370	2086502.500	0.0	1.3	Aroclor-1254	350.000	350.000	NA	12400.0	ug/kg
SED60392	Oct-92	Sed	752038.370	2086502.500	0.0	1.3	Mercury	0.350	NA	0.340	25200.0	mg/kg
SED60392	Oct-92	Sed	752038.370	2086502.500	0.0	1.3	Plutonium-239/240	25.670	NA	1.350	50.0	pCi/g
SED60392	Oct-92	Sed	752038.370	2086502.500	0.0	1.3	Toluene	280.000	5.000	NA	31300000.0	ug/kg
Pond A-2												
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	1234678-HpCDD	19.900	2.860	NA	NA	pg/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	2-Butanone	34.000	20.000	NA	192000000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	Acetone	230.000	20.000	NA	102000000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	Americium-241	1.060	NA	0.270	76.0	pCi/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	bis(2-Ethylhexyl)phthalate	1000.000	300.000	NA	1970000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	Methylene chloride	9.300	3.500	NA	2530000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	O8CDD	161.000	5.710	NA	NA	pg/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	OCDF	8.830	5.710	NA	NA	pg/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	Plutonium-239/240	2.990	NA	1.350	50.0	pCi/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.0	0.5	Uranium-238	6.100	NA	3.460	351.0	pCi/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	2-Butanone	71.000	14.000	NA	192000000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Acetone	400.000	14.000	NA	102000000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Aluminum	28000.000	NA	15713.070	228000.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Americium-241	1.440	NA	0.270	76.0	pCi/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Aroclor-1254	34.000	20.000	NA	12400.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Arsenic	12.000	NA	7.240	22.2	mg/kg

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Barium	300.000	NA	188.170	26400.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	bis(2-Ethylhexyl)phthalate	420.000	210.000	NA	1970000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Cadmium	3.200	NA	1.880	962.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Chromium	29.000	NA	23.230	268.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Copper	56.000	NA	27.270	40900.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Iron	27000.000	NA	21379.010	307000.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Methylene chloride	5.600	2.400	NA	2530000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Nickel	25.000	NA	17.890	20400.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	O8CDD	17.800	8.380	NA	NA	pg/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Plutonium-239/240	4.250	NA	1.350	50.0	pCi/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Vanadium	57.000	NA	46.830	7150.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	0.5	2.5	Zinc	160.000	NA	104.400	307000.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	1234678-HpCDD	19.800	4.740	NA	NA	pg/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Acetone	77.000	21.000	NA	102000000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Aluminum	49000.000	NA	15713.070	228000.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Americium-241	1.320	NA	0.270	76.0	pCi/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Aroclor-1254	36.000	30.000	NA	12400.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Arsenic	11.000	NA	7.240	22.2	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Barium	390.000	NA	188.170	26400.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Benzoic Acid	2700.000	1300.000	NA	1000000000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	bis(2-Ethylhexyl)phthalate	490.000	320.000	NA	1970000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Chromium	44.000	NA	23.230	268.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Cobalt	15.000	NA	12.300	1550.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Copper	49.000	NA	27.270	40900.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Iron	39000.000	NA	21379.010	307000.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Lithium	37.000	NA	29.670	20400.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Manganese	900.000	NA	659.220	3480.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Methylene chloride	7.700	3.700	NA	2530000.0	ug/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Nickel	34.000	NA	17.890	20400.0	mg/kg

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	O8CDD	114.000	9.480	NA	NA	pg/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Plutonium-239/240	3.590	NA	1.350	50.0	pCi/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Strontium	220.000	NA	201.440	613000.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Uranium-238	4.530	NA	3.460	351.0	pCi/g
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Vanadium	96.000	NA	46.830	7150.0	mg/kg
CW54-000	Dec-04	Sed	752172.691	2087344.578	2.5	4.5	Zinc	170.000	NA	104.400	307000.0	mg/kg
CW54-000	Dec-04	Soil	752172.691	2087344.578	4.5	6.5	2-Butanone	12.000	6.400	NA	192000000.0	ug/kg
CW54-000	Dec-04	Soil	752172.691	2087344.578	4.5	6.5	Acetone	52.000	6.300	NA	102000000.0	ug/kg
CW54-000	Dec-04	Soil	752172.691	2087344.578	4.5	6.5	Americium-241	1.400	NA	0.020	76.0	pCi/g
CW54-000	Dec-04	Soil	752172.691	2087344.578	4.5	6.5	bis(2-Ethylhexyl)phthalate	250.000	96.000	NA	1970000.0	ug/kg
CW54-000	Dec-04	Soil	752172.691	2087344.578	4.5	6.5	Methylene chloride	2.600	1.100	NA	2530000.0	ug/kg
CW54-000	Dec-04	Soil	752172.691	2087344.578	4.5	6.5	O8CDD	8.350	3.330	NA	NA	pg/g
CW54-000	Dec-04	Soil	752172.691	2087344.578	4.5	6.5	Plutonium-239/240	2.610	NA	0.020	50.0	pCi/g
CW54-000	Dec-04	Soil	752172.691	2087344.578	4.5	6.5	Uranium-238	2.070	NA	1.490	351.0	pCi/g
CW54-000	Dec-04	Soil	752172.691	2087344.578	6.5	8.5	Acetone	34.000	5.200	NA	102000000.0	ug/kg
CW54-000	Dec-04	Soil	752172.691	2087344.578	6.5	8.5	Methylene chloride	2.700	0.900	NA	2530000.0	ug/kg
SED60792	Nov-92	Sed	752173.870	2087291.120	0.0	0.5	Americium-241	1.514	NA	0.270	76.0	pCi/g
SED60792	Jun-94	Sed	752173.870	2087291.120	0.0	0.5	Plutonium-239/240	4.747	NA	1.350	50.0	pCi/g
SED60792	Jun-94	Sed	752173.870	2087291.120	0.0	0.5	Uranium-235	0.161	NA	0.150	8.0	pCi/g
SED60792	Jun-94	Sed	752173.870	2087291.120	0.0	0.5	Uranium-238	5.792	NA	3.460	351.0	pCi/g
SED60792	Nov-92	Sed	752173.870	2087291.120	0.0	1.0	Americium-241	1.740	NA	0.270	76.0	pCi/g
SED60792	Nov-92	Sed	752173.870	2087291.120	0.0	1.0	bis(2-Ethylhexyl)phthalate	4200.000	660.000	NA	1970000.0	ug/kg
SED60792	Nov-92	Sed	752173.870	2087291.120	0.0	1.0	Plutonium-239/240	5.650	NA	1.350	50.0	pCi/g
SED60792	Nov-92	Sed	752173.870	2087291.120	0.0	1.0	Toluene	860.000	5.000	NA	31300000.0	ug/kg
SED60892	Jun-94	Sed	752175.370	2087329.120	0.0	0.5	Americium-241	1.073	NA	0.270	76.0	pCi/g
SED60892	Jun-94	Sed	752175.370	2087329.120	0.0	0.5	Plutonium-239/240	3.081	NA	1.350	50.0	pCi/g
SED60892	Jun-94	Sed	752175.370	2087329.120	0.0	0.5	Uranium-238	5.948	NA	3.460	351.0	pCi/g
SED60892	Nov-92	Sed	752175.370	2087329.120	0.0	1.3	Acetone	260.000	100.000	NA	102000000.0	ug/kg
SED60892	Nov-92	Sed	752175.370	2087329.120	0.0	1.3	bis(2-	7800.000	660.000	NA	1970000.0	ug/kg

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
							Ethylhexyl)phthalate					
SED60892	Nov-92	Sed	752175.370	2087329.120	0.0	1.3	Nickel	28.300	NA	17.890	20400.0	mg/kg
SED60892	Nov-92	Sed	752175.370	2087329.120	0.0	1.3	Plutonium-239/240	2.580	NA	1.350	50.0	pCi/g
Pond A-3												
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Aluminum	27400.000	NA	15713.070	228000.0	mg/kg
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Americium-241	0.666	NA	0.270	76.0	pCi/g
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Arsenic	7.500	NA	7.240	22.2	mg/kg
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Barium	192.000	NA	188.170	26400.0	mg/kg
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Chromium	29.900	NA	23.230	268.0	mg/kg
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Iron	25000.000	NA	21379.010	307000.0	mg/kg
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Nickel	25.600	NA	17.890	20400.0	mg/kg
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Plutonium-239/240	2.053	NA	1.350	50.0	pCi/g
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Toluene	6.000	5.000	NA	31300000.0	ug/kg
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Vanadium	62.700	NA	46.830	7150.0	mg/kg
SED61092	Oct-92	Sed	752377.930	2088256.750	0.0	2.0	Zinc	122.000	NA	104.400	307000.0	mg/kg
SED61192	Oct-92	Sed	752367.120	2088213.000	0.0	1.3	Aluminum	25800.000	NA	15713.070	228000.0	mg/kg
SED61192	Oct-92	Sed	752367.120	2088213.000	0.0	1.3	Americium-241	0.333	NA	0.270	76.0	pCi/g
SED61192	Oct-92	Sed	752367.120	2088213.000	0.0	1.3	Chromium	25.900	NA	23.230	268.0	mg/kg
SED61192	Oct-92	Sed	752367.120	2088213.000	0.0	1.3	Iron	24400.000	NA	21379.010	307000.0	mg/kg
SED61192	Oct-92	Sed	752367.120	2088213.000	0.0	1.3	Nickel	19.700	NA	17.890	20400.0	mg/kg
SED61192	Oct-92	Sed	752367.120	2088213.000	0.0	1.3	Toluene	45.000	5.000	NA	31300000.0	ug/kg
SED61192	Oct-92	Sed	752367.120	2088213.000	0.0	1.3	Vanadium	60.100	NA	46.830	7150.0	mg/kg
SED61192	Oct-92	Sed	752367.120	2088213.000	0.0	1.3	Zinc	155.000	NA	104.400	307000.0	mg/kg
SED61292	Oct-92	Sed	752289.250	2088051.750	0.0	1.0	Americium-241	0.422	NA	0.270	76.0	pCi/g
SED61292	Oct-92	Sed	752289.250	2088051.750	0.0	1.0	Antimony	26.000	NA	13.010	409.0	mg/kg
SED61292	Oct-92	Sed	752289.250	2088051.750	0.0	1.0	Cobalt	13.900	NA	12.300	1550.0	mg/kg
SED61292	Oct-92	Sed	752289.250	2088051.750	0.0	1.0	Toluene	17.000	5.000	NA	31300000.0	ug/kg
SED61292	Oct-92	Sed	752289.250	2088051.750	0.0	1.0	Zinc	132.000	NA	104.400	307000.0	mg/kg
SED61392	Oct-92	Sed	752518.750	2088293.870	0.0	1.3	Aluminum	19900.000	NA	15713.070	228000.0	mg/kg
SED61392	Oct-92	Sed	752518.750	2088293.870	0.0	1.3	Arsenic	7.800	NA	7.240	22.2	mg/kg

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
SED61392	Oct-92	Sed	752518.750	2088293.870	0.0	1.3	Cobalt	15.500	NA	12.300	1550.0	mg/kg
SED61392	Oct-92	Sed	752518.750	2088293.870	0.0	1.3	Iron	22600.000	NA	21379.010	307000.0	mg/kg
SED61392	Oct-92	Sed	752518.750	2088293.870	0.0	1.3	Toluene	62.000	5.000	NA	31300000.0	ug/kg
SED61392	Oct-92	Sed	752518.750	2088293.870	0.0	1.3	Vanadium	47.600	NA	46.830	7150.0	mg/kg
SED61392	Oct-92	Sed	752518.750	2088293.870	0.0	1.3	Zinc	146.000	NA	104.400	307000.0	mg/kg
Pond A-4												
SED61592	Oct-92	Sed	752864.120	2089474.370	0.0	0.7	Antimony	27.500	NA	13.010	409.0	mg/kg
SED61592	Oct-92	Sed	752864.120	2089474.370	0.0	0.7	Cobalt	13.100	NA	12.300	1550.0	mg/kg
SED61592	Oct-92	Sed	752864.120	2089474.370	0.0	0.7	Nickel	23.200	NA	17.890	20400.0	mg/kg
SED61692	Oct-92	Sed	752957.620	2089755.750	0.0	0.3	Aluminum	17900.000	NA	15713.070	228000.0	mg/kg
SED61692	Oct-92	Sed	752957.620	2089755.750	0.0	0.3	Antimony	41.400	NA	13.010	409.0	mg/kg
SED61692	Oct-92	Sed	752957.620	2089755.750	0.0	0.3	Arsenic	8.800	NA	7.240	22.2	mg/kg
SED61692	Oct-92	Sed	752957.620	2089755.750	0.0	0.3	Nickel	25.500	NA	17.890	20400.0	mg/kg
SED61692	Oct-92	Sed	752957.620	2089755.750	0.0	0.3	Toluene	5.000	5.000	NA	31300000.0	ug/kg
SED61692	Oct-92	Sed	752957.620	2089755.750	0.0	0.3	Zinc	115.000	NA	104.400	307000.0	mg/kg
SED61792	Oct-92	Sed	752938.430	2089465.500	0.0	0.7	Antimony	27.100	NA	13.010	409.0	mg/kg
SED61792	Oct-92	Sed	752938.430	2089465.500	0.0	0.7	Nickel	21.000	NA	17.890	20400.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Aluminum	22900.000	NA	15713.070	228000.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Arsenic	10.200	NA	7.240	22.2	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Barium	206.000	NA	188.170	26400.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	bis(2-Ethylhexyl)phthalate	950.000	660.000	NA	1970000.0	ug/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Cadmium	3.100	NA	1.880	962.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Chromium	23.800	NA	23.230	268.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Cobalt	13.900	NA	12.300	1550.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Copper	33.400	NA	27.270	40900.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Iron	22900.000	NA	21379.010	307000.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Selenium	1.900	NA	1.550	5110.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Toluene	8.000	5.000	NA	31300000.0	ug/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Vanadium	57.700	NA	46.830	7150.0	mg/kg
SED61892	Oct-92	Sed	753000.430	2089699.500	0.0	0.4	Zinc	169.000	NA	104.400	307000.0	mg/kg

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
Pond A-5												
A50102	Jan-02	Soil	753646.978	2093596.835	0.1	0.2	Iron	20800.000	NA	18037.000	307000.0	mg/kg
A50102	Jan-02	Soil	753646.978	2093596.835	0.1	0.2	Nickel	17.200	NA	14.910	20400.0	mg/kg
A50102	Jan-02	Soil	753646.978	2093596.835	0.1	0.2	Plutonium-239/240	0.285	NA	0.066	50.0	pCi/g
A50102	Jan-02	Soil	753646.978	2093596.835	2.0	6.0	Americium-241	0.076	NA	0.020	76.0	pCi/g
A50102	Jan-02	Soil	753646.978	2093596.835	2.0	6.0	Plutonium-239/240	0.065	NA	0.020	50.0	pCi/g
A50202	Jan-02	Soil	753661.228	2093604.270	0.1	0.2	Americium-241	0.122	NA	0.023	76.0	pCi/g
A50202	Jan-02	Soil	753661.228	2093604.270	0.1	0.2	Cadmium	1.630	NA	1.612	962.0	mg/kg
A50202	Jan-02	Soil	753661.228	2093604.270	0.1	0.2	Lithium	11.900	NA	11.550	20400.0	mg/kg
A50202	Jan-02	Soil	753661.228	2093604.270	0.1	0.2	Plutonium-239/240	0.239	NA	0.066	50.0	pCi/g
A50202	Jan-02	Soil	753661.228	2093604.270	2.0	6.0	Americium-241	0.032	NA	0.020	76.0	pCi/g
A50202	Jan-02	Soil	753661.228	2093604.270	2.0	6.0	Plutonium-239/240	0.040	NA	0.020	50.0	pCi/g
A50302	Jan-02	Soil	753737.746	2093577.628	2.0	6.0	Uranium, Total	10.500	NA	3.040	2750.0	mg/kg
A50402	Jan-02	Soil	753725.355	2093603.650	0.1	0.2	Lithium	13.100	NA	11.550	20400.0	mg/kg
A50502	Jan-02	Soil	753708.006	2093622.857	0.1	0.2	Lithium	11.800	NA	11.550	20400.0	mg/kg
A50502	Jan-02	Soil	753708.006	2093622.857	0.1	0.2	Nickel	18.200	NA	14.910	20400.0	mg/kg
A50502	Jan-02	Soil	753708.006	2093622.857	0.1	0.2	Strontium	56.000	NA	48.940	613000.0	mg/kg
A50602	Jan-02	Soil	753681.365	2093640.205	0.1	0.2	Nickel	15.600	NA	14.910	20400.0	mg/kg
A50602	Jan-02	Soil	753681.365	2093640.205	2.0	6.0	Lithium	11000.000	NA	34.660	20400.0	mg/kg
A50702	Jan-02	Soil	753654.723	2093656.934	0.1	0.2	Cadmium	1.700	NA	1.612	962.0	mg/kg
A50702	Jan-02	Soil	753654.723	2093656.934	0.1	0.2	Lithium	11.600	NA	11.550	20400.0	mg/kg
A50702	Jan-02	Soil	753654.723	2093656.934	2.0	6.0	Lithium	9870.000	NA	34.660	20400.0	mg/kg
A50802	Jan-02	Soil	753628.701	2093666.847	0.1	0.2	Strontium	52.700	NA	48.940	613000.0	mg/kg
A50802	Jan-02	Soil	753628.701	2093666.847	2.0	6.0	Lithium	14600.000	NA	34.660	20400.0	mg/kg
SED64592	Oct-92	Sed	753658.180	2093536.120	0.0	0.5	Acetone	210.000	100.000	NA	102000000.0	ug/kg
SED64592	Oct-92	Sed	753658.180	2093536.120	0.0	0.5	Toluene	18.000	5.000	NA	31300000.0	ug/kg
SED64692	Oct-92	Sed	753622.870	2093562.250	0.0	1.9	Toluene	16.000	5.000	NA	31300000.0	ug/kg
SED64792	Oct-92	Sed	753756.750	2093507.370	0.0	0.4	Toluene	18.000	5.000	NA	31300000.0	ug/kg
SED64892	Oct-92	Sed	753678.500	2093564.250	0.0	1.0	Toluene	13.000	5.000	NA	31300000.0	ug/kg
SED64992	Oct-92	Sed	753745.930	2093451.620	0.0	0.7	Cobalt	13.300	NA	12.300	1550.0	mg/kg

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
SED64992	Oct-92	Sed	753745.930	2093451.620	0.0	0.7	Nickel	18.100	NA	17.890	20400.0	mg/kg
Pond B-4												
SED63692	Oct-92	Sed	750932.310	2088212.870	0.0	1.3	Americium-241	0.458	NA	0.270	76.0	pCi/g
SED63692	Oct-92	Sed	750932.310	2088212.870	0.0	1.3	Fluoranthene	750.000	660.000	NA	27200000.0	ug/kg
SED63692	Oct-92	Sed	750932.310	2088212.870	0.0	1.3	Zinc	153.000	NA	104.400	307000.0	mg/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Americium-241	0.588	NA	0.270	76.0	pCi/g
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Aroclor-1254	440.000	350.000	NA	12400.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Arsenic	7.400	NA	7.240	22.2	mg/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Benzo(b)fluoranthene	1000.000	660.000	NA	34900.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	bis(2-Ethylhexyl)phthalate	2600.000	660.000	NA	1970000.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Copper	29.900	NA	27.270	40900.0	mg/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Fluoranthene	1100.000	660.000	NA	27200000.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Nickel	19.000	NA	17.890	20400.0	mg/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Pyrene	860.000	660.000	NA	22100000.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Toluene	360.000	5.000	NA	31300000.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.0	Zinc	319.000	NA	104.400	307000.0	mg/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Americium-241	2.560	NA	0.270	76.0	pCi/g
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Aroclor-1254	560.000	350.000	NA	12400.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Benzo(b)fluoranthene	1500.000	660.000	NA	34900.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Benzo(k)fluoranthene	350.000	330.000	NA	349000.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	bis(2-Ethylhexyl)phthalate	3200.000	660.000	NA	1970000.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Copper	32.200	NA	27.270	40900.0	mg/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Fluoranthene	1400.000	660.000	NA	27200000.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	gamma-BHC	25.000	8.000	NA	25500.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Nickel	22.000	NA	17.890	20400.0	mg/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Plutonium-239/240	9.577	NA	1.350	50.0	pCi/g
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Pyrene	1200.000	660.000	NA	22100000.0	ug/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Silver	19.600	NA	2.280	5110.0	mg/kg
SED63792	Oct-92	Sed	750880.810	2088254.750	0.0	2.5	Zinc	197.000	NA	104.400	307000.0	mg/kg

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Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Americium-241	0.485	NA	0.270	76.0	pCi/g
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Antimony	25.600	NA	13.010	409.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Arsenic	8.800	NA	7.240	22.2	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Barium	196.000	NA	188.170	26400.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Benzo(b)fluoranthene	660.000	660.000	NA	34900.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	bis(2-Ethylhexyl)phthalate	2100.000	660.000	NA	1970000.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Cadmium	3.200	NA	1.880	962.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Copper	30.200	NA	27.270	40900.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Fluoranthene	950.000	660.000	NA	27200000.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Pyrene	820.000	660.000	NA	22100000.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Toluene	17.000	5.000	NA	31300000.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.0	Zinc	303.000	NA	104.400	307000.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Americium-241	7.452	NA	0.270	76.0	pCi/g
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Aroclor-1254	1100.000	350.000	NA	12400.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Arsenic	7.300	NA	7.240	22.2	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Barium	190.000	NA	188.170	26400.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Benzo(b)fluoranthene	770.000	660.000	NA	34900.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Benzo(k)fluoranthene	360.000	330.000	NA	349000.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	bis(2-Ethylhexyl)phthalate	5000.000	660.000	NA	1970000.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Cadmium	1.900	NA	1.880	962.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Chromium	26.100	NA	23.230	268.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Copper	38.400	NA	27.270	40900.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Fluoranthene	1100.000	660.000	NA	27200000.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Plutonium-239/240	24.090	NA	1.350	50.0	pCi/g
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Pyrene	1000.000	660.000	NA	22100000.0	ug/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Silver	102.000	NA	2.280	5110.0	mg/kg
SED63892	Oct-92	Sed	750889.250	2088223.370	0.0	2.8	Zinc	194.000	NA	104.400	307000.0	mg/kg
Pond B-5												
B5	Oct-97	Sed	752069.000	2089509.000	0.0	0.5	Carbon Tetrachloride	440.000	5.000	NA	81500.0	ug/kg

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
OUTLET (N)												
B5 OUTLET (N)	Oct-97	Sed	752069.000	2089509.000	0.0	0.5	Methylene chloride	420.000	5.000	NA	2530000.0	ug/kg
B5 OUTLET (S)	Oct-97	Sed	751946.688	2089600.000	0.0	0.5	Carbon Tetrachloride	390.000	5.000	NA	81500.0	ug/kg
B5 OUTLET (S)	Oct-97	Sed	751946.688	2089600.000	0.0	0.5	Methylene chloride	410.000	5.000	NA	2530000.0	ug/kg
SED64092	Oct-92	Sed	751734.180	2089080.370	0.0	0.8	Nickel	18.600	NA	17.890	20400.0	mg/kg
SED64092	Oct-92	Sed	751734.180	2089080.370	0.0	0.8	Toluene	21.000	5.000	NA	31300000.0	ug/kg
SED64192	Oct-92	Sed	751923.500	2089540.120	0.0	0.4	Aluminum	20400.000	NA	15713.070	228000.0	mg/kg
SED64192	Oct-92	Sed	751923.500	2089540.120	0.0	0.4	Arsenic	8.300	NA	7.240	22.2	mg/kg
SED64192	Oct-92	Sed	751923.500	2089540.120	0.0	0.4	Nickel	19.200	NA	17.890	20400.0	mg/kg
SED64192	Oct-92	Sed	751923.500	2089540.120	0.0	0.4	Toluene	12.000	5.000	NA	31300000.0	ug/kg
SED64192	Oct-92	Sed	751923.500	2089540.120	0.0	0.4	Vanadium	47.800	NA	46.830	7150.0	mg/kg
SED64292	Oct-92	Sed	752081.620	2089465.500	0.0	0.3	Aluminum	16500.000	NA	15713.070	228000.0	mg/kg
SED64292	Oct-92	Sed	752081.620	2089465.500	0.0	0.3	Nickel	19.700	NA	17.890	20400.0	mg/kg
SED64292	Oct-92	Sed	752081.620	2089465.500	0.0	0.3	Toluene	17.000	5.000	NA	31300000.0	ug/kg
SED64292	Oct-92	Sed	752081.620	2089465.500	0.0	0.3	Zinc	112.000	NA	104.400	307000.0	mg/kg
SED64392	Oct-92	Sed	751994.310	2089520.500	0.0	1.0	Aluminum	17900.000	NA	15713.070	228000.0	mg/kg
SED64392	Oct-92	Sed	751994.310	2089520.500	0.0	1.0	Americium-241	0.305	NA	0.270	76.0	pCi/g
SED64392	Oct-92	Sed	751994.310	2089520.500	0.0	1.0	Arsenic	8.600	NA	7.240	22.2	mg/kg
SED64392	Oct-92	Sed	751994.310	2089520.500	0.0	1.0	Barium	194.000	NA	188.170	26400.0	mg/kg
SED64392	Oct-92	Sed	751994.310	2089520.500	0.0	1.0	Copper	29.900	NA	27.270	40900.0	mg/kg
SED64392	Oct-92	Sed	751994.310	2089520.500	0.0	1.0	Nickel	23.800	NA	17.890	20400.0	mg/kg
SED64392	Oct-92	Sed	751994.310	2089520.500	0.0	1.0	Toluene	25.000	5.000	NA	31300000.0	ug/kg
SED64392	Oct-92	Sed	751994.310	2089520.500	0.0	1.0	Zinc	174.000	NA	104.400	307000.0	mg/kg
SED64492	Oct-92	Sed	751639.250	2088979.870	0.0	0.3	Aluminum	15900.000	NA	15713.070	228000.0	mg/kg
SED64492	Oct-92	Sed	751639.250	2088979.870	0.0	0.3	Tin	39.500	NA	29.270	613000.0	mg/kg

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analyte	Result	MDL or RL	Background Mean Plus Two Standard Deviations	WRW AL	Unit
SED64492	Oct-92	Sed	751639.250	2088979.870	0.0	0.3	Toluene	47.000	5.000	NA	31300000.0	ug/kg
Pond C-2												
SED512	Nov-92	Sed	747570.560	2088928.000	0.0	0.3	Americium-241	0.420	NA	0.270	76.0	pCi/g
SED512	Nov-92	Sed	747570.560	2088928.000	0.0	0.3	Mercury	0.650	NA	0.340	25200.0	mg/kg
SED512	Nov-92	Sed	747570.560	2088928.000	0.0	0.3	Nickel	18.100	NA	17.890	20400.0	mg/kg
SED512	Nov-92	Sed	747570.560	2088928.000	0.0	0.3	Plutonium-239/240	2.100	NA	1.350	50.0	pCi/g
SED512	Nov-92	Sed	747570.560	2088928.000	0.0	0.3	Toluene	340.000	5.000	NA	31300000.0	ug/kg
SED512	Nov-92	Sed	747570.560	2088928.000	0.0	0.3	Zinc	150.000	NA	104.400	307000.0	mg/kg
SED513	Nov-92	Sed	747499.250	2088999.870	0.0	0.4	Americium-241	0.340	NA	0.270	76.0	pCi/g
SED513	Nov-92	Sed	747499.250	2088999.870	0.0	0.4	Arsenic	9.800	NA	7.240	22.2	mg/kg
SED513	Nov-92	Sed	747499.250	2088999.870	0.0	0.4	Barium	226.000	NA	188.170	26400.0	mg/kg
SED513	Nov-92	Sed	747499.250	2088999.870	0.0	0.4	Copper	35.900	NA	27.270	40900.0	mg/kg
SED513	Nov-92	Sed	747499.250	2088999.870	0.0	0.4	Mercury	0.680	NA	0.340	25200.0	mg/kg
SED513	Nov-92	Sed	747499.250	2088999.870	0.0	0.4	Plutonium-239/240	2.400	NA	1.350	50.0	pCi/g
SED513	Nov-92	Sed	747499.250	2088999.870	0.0	0.4	Toluene	370.000	5.000	NA	31300000.0	ug/kg
SED513	Nov-92	Sed	747499.250	2088999.870	0.0	0.4	Zinc	201.000	NA	104.400	307000.0	mg/kg

Table 3
Locations With All Nondetected Analytes

Location Code	Sample Date	Media	Northing	Easting	Starting Depth (ft bgs)	Ending Depth (ft bgs)	Analytes
SED60092	Jun-94	Sed	752021.870	2086548.620	0	0.5	PCBs
SED60392	Jun-94	Sed	752038.370	2086502.500	0	0.5	PCBs
SED60792	Jun-94	Sed	752173.870	2087291.120	0	0.5	PCBs
SED61092	Jun-94	Sed	752377.930	2088256.750	0	0.5	PCBs
SED61192	Jun-94	Sed	752367.120	2088213.000	0	0.5	PCBs
SED61292	Jun-94	Sed	752289.250	2088051.750	0	0.5	PCBs
SED61392	Jun-94	Sed	752518.750	2088293.870	0	0.5	PCBs
SED61592	Jul-94	Sed	752864.120	2089474.370	0	0.5	PCBs
SED61692	Jul-94	Sed	752957.620	2089755.750	0	0.5	PCBs
SED61792	Jul-94	Sed	752938.430	2089465.500	0	0.5	PCBs
SED61892	Jul-94	Sed	753000.430	2089699.500	0	0.5	PCBs
SED63692	Jun-94	Sed	750932.310	2088212.870	0	0.5	PCBs
SED63792	Jun-94	Sed	750880.810	2088254.750	0	0.5	PCBs
SED63892	Jun-94	Sed	750889.250	2088223.370	0	0.5	PCBs
SED64092	Jun-94	Sed	751734.180	2089080.370	0	0.5	PCBs
SED64192	Jun-94	Sed	751923.500	2089540.120	0	0.5	PCBs
SED64292	Jun-94	Sed	752081.620	2089465.500	0	0.5	PCBs
SED64392	Jun-94	Sed	751994.310	2089520.500	0	0.5	PCBs
SED64492	Jun-94	Sed	751639.250	2088979.870	0	0.5	PCBs

Table 4
RFCA Radionuclide SORs

Location Code	Sample Starting Depth (ft)	Sample Ending Depth (ft)	SOR
Pond A-1			
SED60092	0	0.5	0.11
SED60092	0	1.5	0.46696
SED60392	0	0.5	0.073956
SED60392	0	1.25	0.372346
CS53-000	1.5	3	0.273775
Pond A-2			
SED60792	0	0.5	0.157774
SED60792	0	1	0.071602
SED60892	0	0.5	0.109591
SED60892	0	1.333333	0.022241
CW54-000	0	0.5	0.057012
Pond A-3			
SED61092	0	2	0.026465
SED61192	0	1.333333	0.004379

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Location Code	Sample Starting Depth (ft)	Sample Ending Depth (ft)	SOR
SED61292	0	1	0.005555
Pond A-4			
Pond A-5			
A50102	0.083333	0.166667	0.002457
A50202	0.083333	0.166667	0.003666
Pond B-4			
SED63692	0	1.333333	0.006032
SED63792	0	2	0.007738
SED63792	0	2.5	0.116245
SED63892	0	2	0.006378
SED63892	0	2.75	0.305725
Pond B-5			
SED64392	0	1	0.004018
Pond C-2			
SED512	0	0.333333	0.02363
SED513	0	0.416667	0.025163

Table 5
RFCA Nonradionuclide SORs

Location Code	Sample Starting Depth (ft)	Sample Ending Depth (ft)	SOR
Pond A-3			
SED61092	0	2	0.111567
Pond A-4			
SED61692	0	0.333	0.101222

2.4 Summary Statistics

Summary statistics for analytes detected at concentrations greater than background means plus two standard deviations or RLs were calculated by analyte for the IHSS Group NE-1 sampling locations, as presented in Tables 6, 7, and 8 for surface and subsurface soil, and sediment, respectively. For metals, only detections greater than background means plus two standard deviations were used to calculate the detection frequency and average concentration. For other analytes, all detections above the RL are included.

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Table 6
Surface Soil Summary Statistics

Analyte	Total Number Samples Analyzed	Detection Frequency	Average Concentration	Maximum Concentration	Standard Deviation	Detection Limit	Background Mean Plus 2SD	Wildlife Refuge Worker Action Level	Unit
Americium-241	2	50.00%	0.122	0.122	-	-	0.023	76	pCi/g
Cadmium	8	25.00%	1.665	1.7	0.049	-	1.612	962	mg/kg
Iron	8	12.50%	20800	20800	-	-	18037.000	307000	mg/kg
Lithium	8	50.00%	12.1	13.1	0.678	-	11.550	20400	mg/kg
Nickel	8	37.50%	17	18.2	1.311	-	14.910	20400	mg/kg
Plutonium-239/240	2	100.00%	0.262	0.285	0.033	-	0.066	50	pCi/g
Strontium	8	25.00%	54.35	56	2.333	-	48.940	613000	mg/kg

Table 7
Subsurface Soil Summary Statistics

Analyte	Total Number Samples Analyzed	Detection Frequency	Average Concentration	Maximum Concentration	Standard Deviation	Detection Limit	Background Mean Plus 2SD	Wildlife Refuge Worker Action Level	Unit
2-Butanone	13	15.38%	10.900	12	1.556	6	-	192000000	ug/kg
Acetone	13	38.46%	43.200	94	31.744	5.52	-	102000000	ug/kg
Americium-241	7	42.86%	0.503	1.4	0.778	-	0.02	76	pCi/g
bis(2-Ethylhexyl)phthalate	5	20.00%	250.000	250	-	96	-	1970000	ug/kg
Cadmium	13	15.38%	2.050	2.3	0.354	-	1.7	962	mg/kg
Carbon Disulfide	13	7.69%	2.500	2.5	-	1.1	-	15100000	ug/kg
Cobalt	13	7.69%	55.000	55	-	-	29.04	1550	mg/kg
Iron	13	15.38%	97500.000	110000	17677.670	-	41046.52	307000	mg/kg
Lithium	13	23.08%	11823.333	14600	2470.148	-	34.66	20400	mg/kg
Manganese	13	7.69%	1400.000	1400	-	-	901.62	3480	mg/kg
Methylene chloride	13	38.46%	2.540	2.7	0.182	0.962	-	2530000	ug/kg
Nickel	13	7.69%	190.000	190	-	-	62.21	20400	mg/kg

Analyte	Total Number Samples Analyzed	Detection Frequency	Average Concentration	Maximum Concentration	Standard Deviation	Detection Limit	Background Mean Plus 2SD	Wildlife Refuge Worker Action Level	Unit
Plutonium-239/240	7	42.86%	0.905	2.61	1.476	-	0.02	50	pCi/g
Toluene	13	7.69%	0.980	0.98	-	0.91	-	31300000	ug/kg
Uranium, Total	13	15.38%	8.100	10.5	3.394	-	3.04	2750	mg/kg
Uranium-238	7	14.29%	2.070	2.07	-	-	1.49	351	pCi/g
Zinc	13	7.69%	300.000	300	-	-	139.1	307000	mg/kg

Table 8
Sediment Summary Statistics

Analyte	Total Number Samples Analyzed	Detection Frequency	Average Concentration	Maximum Concentration	Standard Deviation	Detection Limit	Background Mean Plus 2SD	Wildlife Refuge Worker Action Level	Unit
2-Butanone	31	6.45%	52.500	71	26.163	17	-	192000000	ug/kg
Acetone	32	18.75%	198.000	400	138.149	43.7	-	102000000	ug/kg
Aluminum	35	34.29%	24216.667	49000	9082.934	-	15713.07	228000	mg/kg
Americium-241	35	62.86%	2.442	12.25	3.542	-	0.27	76	pCi/g
Antimony	27	22.22%	29.533	41.4	5.981	-	13.01	409	mg/kg
Aroclor-1254	51	13.73%	444.286	1100	367.088	257.143	-	12400	ug/kg
Aroclor-1260	50	2.00%	150.000	150	-	2.2	-	12400	ug/kg
Arsenic	35	37.14%	8.862	12	1.483	-	7.24	22.2	mg/kg
Barium	35	28.57%	231.700	390	64.917	-	188.17	26400	mg/kg
Benzo(b)fluoranthene	32	12.50%	982.500	1500	372.950	660	-	34900	ug/kg
Benzo(k)fluoranthene	32	6.25%	355.000	360	7.071	330	-	349000	ug/kg
Benzoic Acid	32	3.13%	2700.000	2700	-	1300	-	1000000000	ug/kg
bis(2-Ethylhexyl)phthalate	32	31.25%	2776.000	7800	2360.491	545	-	1970000	ug/kg
Cadmium	34	17.65%	2.800	3.4	0.666	-	1.88	962	mg/kg
Carbon Tetrachloride	32	6.25%	415.000	440	35.355	5	-	81500	ug/kg
Chromium	35	20.00%	29.529	44	6.707	-	23.23	268	mg/kg
Cobalt	35	17.14%	14.117	15.5	0.947	-	12.3	1550	mg/kg

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Analyte	Total Number Samples Analyzed	Detection Frequency	Average Concentration	Maximum Concentration	Standard Deviation	Detection Limit	Background Mean Plus 2SD	Wildlife Refuge Worker Action Level	Unit
Copper	35	31.43%	36.964	56	8.922	-	27.27	40900	mg/kg
Fluoranthene	32	18.75%	1015.000	1400	239.896	660	-	27200000	ug/kg
gamma-BHC	27	3.70%	25.000	25	-	8	-	25500	ug/kg
Indeno(1,2,3-cd)pyrene	32	3.13%	210.000	210	-	34	-	34900	ug/kg
Iron	35	20.00%	26271.429	39000	5819.712	-	21379.01	307000	mg/kg
Lithium	35	2.86%	37.000	37	-	-	29.67	20400	mg/kg
Manganese	35	2.86%	900.000	900	-	-	659.22	3480	mg/kg
Mercury	35	11.43%	0.510	0.68	0.179	-	0.34	25200	mg/kg
Methylene chloride	32	18.75%	142.717	420	210.942	3.483	-	2530000	ug/kg
Nickel	35	48.57%	22.518	34	4.246	-	17.89	20400	mg/kg
Phenol	32	3.13%	54.000	54	-	53	-	613000000	ug/kg
Plutonium-239/240	37	45.95%	8.839	35.47	10.203	-	1.35	50	pCi/g
Pyrene	32	15.63%	918.000	1200	188.733	660	-	22100000	ug/kg
Selenium	34	2.94%	1.900	1.9	-	-	1.55	5110	mg/kg
Silver	34	5.88%	60.800	102	58.266	-	2.28	5110	mg/kg
Strontium	35	2.86%	220.000	220	-	-	201.44	613000	mg/kg
Tin	35	2.86%	39.500	39.5	-	-	29.27	613000	mg/kg
Toluene	32	68.75%	125.318	860	207.703	5	-	31300000	ug/kg
Uranium-235	35	8.57%	0.235	0.352	0.102	-	0.15	8	pCi/g
Uranium-238	35	20.00%	4.857	6.1	1.063	-	3.46	351	pCi/g
Vanadium	35	22.86%	60.738	96	15.235	-	46.83	7150	mg/kg
Zinc	35	54.29%	168.526	319	57.715	-	104.4	307000	mg/kg

3.0 RCRA UNIT CLOSURE

The ponds are not RCRA units; therefore, RCRA Unit information is not applicable.

4.0 SUBSURFACE SOIL RISK SCREEN

The Subsurface Soil Risk Screen (SSRS) follows the steps identified on Figure 3 in Attachment 5 of RFCA (DOE et al. 2003). Screens 2 and 3 are omitted when all COCs are below WRW ALs.

Screen 1 – Are the COC concentrations below RFCA Table 3 WRW soil ALs?

Yes. As shown in Table 3, there are no COC concentrations or activities greater than the WRW ALs.

Screen 4 – Is there an environmental pathway and sufficient quantity of COCs that would cause an exceedance of the surface water standards?

Yes. However, the quantity of COCs at IHSS Group NE-1 is very low. The only COCs exceeding 10 percent of the WRW ALs are aluminum, arsenic, chromium, iron, and manganese. COCs that exceeded 10 percent of the WRW ALs in subsurface soil or sediment are listed in Table 9.

Table 9
COCs Greater Than 10 Percent of the WRW ALs

Analyte	Number of Locations	Maximum Concentration	Depth (ft)	Background Concentration	WRW AL	Unit
Aluminum	5	49000	2.5–4.5	15713.07	228000	mg/kg
Arsenic	9	12	0.5–2.5	7.24	22.2	mg/kg
Chromium	3	44	2.5–4.5	23.23	268	mg/kg
Iron	1	39000	2.5–4.5	21379.01	307000	mg/kg
Manganese	1	900	2.5–4.5	659.22	3480	mg/kg

As shown in Table 9, the contaminant concentrations are low compared to WRW ALs and generally only slightly greater than background or the RLs. Additionally, all radionuclide activities at depths greater than 3 ft were less than 10 percent of their respective WRW ALs.

Contaminant migration via erosion from a significant storm event or flooding is a possible pathway whereby surface water could be affected by IHSS Group NE-1 pond sediment and soil. However, the ponds are configured to protect off-site water sources. Storm water runoff is retained in the terminal ponds and sampled. If the surface water results meet applicable standards, the water is released. Erosion of the pond sediments because of a large influx of water (from a storm) is not likely because the ponds are currently and expected to remain as low-energy ponds, and less water will be available after Site closure. Additionally, predictions of contaminant migration based on the integration of the Water Erosion Prediction Project (WEPP) (USDA 1995) and Hydraulic Engineering Center (HEC)-6T (Thomas 1999) models are conservative. Site empirical data indicate contaminant migration is less than model predictions. Additional details can be found in the Report on Soil Erosion and Surface Water Sediment Transport Modeling for Actinide Migration Evaluations (DOE 2000).

Although it is possible that contaminants from IHSS Group NE-1 could enter groundwater via dissolution in infiltrating precipitation, the impact would be minimal because the amount of contamination present is minimal. Groundwater beneath IHSS Group NE-1 is contaminated with VOCs. These analytes were not detected in IHSS Group NE-1 and have sources in other areas of the IA. Groundwater is evaluated in the Groundwater Interim Measure/Interim Remedial Action (IM/IRA) (DOE 2005c). Additionally, potential groundwater impacts to surface water from RFETS activities would occur before surface water left the Site.

5.0 ECOLOGICAL EVALUATION

In accordance with the CRA Methodology (DOE 2004d), an ecological screen was conducted to determine whether additional actions are warranted to protect ecological receptors. There are a number of differences between the accelerated action approach and the ecological screening approach as follows:

- Risk for the ecological screen is calculated on an Aquatic Exposure Unit (EU) (AEU) basis, not on an individual pond or sampling location basis. Risk is calculated within AEUs to determine the risk to aquatic populations from contaminants in the watersheds. A point-by-point comparison of the analytical results to the ecological screening levels (ESLs) is not required because risk is calculated for populations of ecological receptors, over space and time. Data comparison methods are briefly described in the next section.

- Background comparisons are addressed differently in the ecological screen than for the accelerated actions. Background values used in the accelerated actions are listed in the IABZSAP, Appendix F (DOE 2004b), and include the lowest non-detected value for analytes with all nondetected results. Background summary statistics used in the ecological screen for background comparisons were calculated using one-half the result for nondetected results.

- Nondetected analytes are eliminated from the accelerated action data comparison. However, for the ecological screen, one-half the result is used for nondetected results when calculating summary statistics.

- The data set used for the ecological screen is dated December 15, 2004, and the data set used for the accelerated action comparison is dated March 29, 2005. Data for some locations (for example, Ponds B-1, B-2, and B-3) that have been remediated may still appear in the ecological screen data set. Additionally, pond data collected in 2005 for the CRA are included in this report. A comparison of these recent data to ecological parameters is included in the appendices.

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5.1 Ecological Chemical of Potential Concern Data Comparisons

The ecological contaminant of potential concern (ECOPC) data comparisons were conducted in accordance with the CRA Methodology (DOE 2004d) in a step-by-step analysis. Comparisons include the following:

- The maximum detected concentration (MDC) of each analyte of interest (AOI) was compared to the ESL, and if greater than the ESL, the analyte was retained for further evaluation.

- Analytes that could not be evaluated because of a lack of available ESLs were retained for further analysis in the CRA uncertainty evaluation.

- If the analyte was detected in more than 5 percent of the samples, the analyte was retained for further evaluation.

- Inorganic analyte distributions were compared to background distributions. If the inorganic analyte distribution was greater than the background distribution, it was retained for further evaluation.

- The exposure point concentration (EPC) (95^{th} percent upper tolerance limit [UTL], that is the 95^{th} percent upper confidence limit [UCL] of the 90^{th} percentile) was compared to the ESL. If the EPC exceeded the ESL, the analyte was retained for further evaluation.

5.2 Risk Characterization

The ecological screen risk characterization was conducted in accordance with the CRA Methodology (DOE 2004d) for analytes that were retained for further evaluation. Characterization criteria include the following:

- Hazard quotients (HQs) were calculated. Analytes that had a range of HQs greater than 1 were retained for further evaluation.

- The spatial distribution of the analyte was evaluated, and if the analysis indicated a depositional trend in a drainage (such as within a pond where there is viable aquatic habitat), the analyte was retained for further evaluation.

- Based on professional judgment, additional research was conducted. Research included toxicology, overall health of the drainage ecosystem, and uncertainty factors.

The A-series ponds are part of the North Walnut Creek AEU (NW AEU), the B-series ponds are part of the South Walnut Creek AEU (SW AEU), and the C-series ponds are part of the Woman Creek AEU (WC AEU). The results of the ecological screen for each AEU are briefly described in the following sections and details are included in Appendices A, B, and C, respectively.

5.3 North Walnut Creek Aquatic Exposure Unit

Several inorganics, semivolatile organic compounds (SVOCs), and one PCB, listed below, were detected in sediment samples and identified as ECOPCs for NW AEU sediment.

Aluminum	Atrazine
Antimony	Benzo(a)anthracene
Barium	Benzo(a)pyrene
Cadmium	Benzo(g,h,i)perylene
Fluoride	Benzo(k)fluoranthene
Iron	Carbazole
Lead	Chrysene
Manganese	Dibenz(a,h)anthracene
Nickel	Fluoranthene
Selenium	Fluorene
Zinc	Indeno(1,2,3-cd)pyrene
2-Methylnaphthalene	Naphthalene
4,4-DDT	Aroclor-1254
Acenaphthene	Phenanthrene
Anthracene	Pyrene

Based on HQ calculations, antimony, fluoride, zinc, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, carbazole, chrysene, dibenz(a,h)anthracene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, Aroclor-1254, phenanthrene, and pyrene required further analysis. These ECOPCs were further evaluated spatially. Depositional trends were not evident for antimony, acenaphthene, anthracene, benzo(g,h,i)perylene, indeno(1,2,3-cd)pyrene, naphthalene, Aroclor-1254, phenanthrene, and pyrene, and these ECOPCs were eliminated from consideration. Fluoride, zinc, benzo(a)anthracene, benzo(a)pyrene, carbazole, chrysene, dibenzo(a,h)anthracene, and fluorene were detected at concentrations greater than ESLs only in the portion of the NW AEU that overlaps the IA and therefore were eliminated from consideration. PAHs and Aroclor-1254 were retained for further evaluation.

PAHs in the NW AEU occur predominantly within the portion of the AEU that overlaps the IA, indicating the drainage itself contains few of the measured values. PAHs within the drainage occur within the channel portion, and were not concentrated in the pond areas. However, as a conservative measure, the PAHs in the ponds were further evaluated. A distinct spatial distribution of PAHs in pond surface sediment was not evident and most measured values were less than toxicity thresholds. Additionally, literature-derived toxicity thresholds from bioassays were obtained for the detected PAH ECOPCs. Results indicate HQs range from possible effect levels (greater than 10) to minimal effect levels (less than 1), indicating the toxicity potential is low.

Aroclor-1254 was the only detected PCB mixture in pond surface sediment. It was detected in 30 of 110 samples, with a range of detected concentrations from 7.3 to 920 micrograms per kilogram (μg/kg) and a mean concentration of 173 μg/kg. The mean is less than the toxic effect threshold for Aroclor-1254 (300 μg/kg). Both in-situ bioassay results and tissue studies at the ponds indicate Aroclor-1254 does not appear to pose a risk to aquatic populations within the ponds (DOE 1995). Appendix A provides additional details of this analysis.

5.4 South Walnut Creek Aquatic Exposure Unit

Several inorganics, SVOCs, and PCBs, listed below, were detected in sediment and carried through the ECOPC process for SW AEU sediment.

Aluminum	Bromomethane
Copper	Carbazole
Fluoride	Chrysene
Lead	Dibenz(a,h)anthracene
Zinc	Fluoranthene
Acenaphthene	Fluorene
Anthracene	Indeno(1,2,3-cd)pyrene
Benzo(a)anthracene	Aroclor-1254
Benzo(a)pyrene	Aroclor-1260
Benzo(g,h,i)perylene	Phenanthrene
Benzo(k)fluoranthene	Pyrene

Based on HQ calculations, fluoride, zinc, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, carbazole, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, Aroclor-1254, Aroclor-1260, phenanthrene, and pyrene required further evaluation. These ECOPCs were further evaluated spatially. Depositional trends were not evident for acenaphthene, fluorene, and Aroclor-1260, and these ECOPCs were eliminated from consideration. Fluoride, carbazole, and dibenzo(a,h)anthracene were only detected in the area of the SW AEU that overlapped the IA and were eliminated from consideration. Zinc, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, chrysene, fluoranthene, indeno(1,2,3-cd)pyrene, Aroclor-1254, phenanthrene, and pyrene were retained for further evaluation.

Aroclor-1254 was the only detected PCB mixture in surface sediments within Pond B-4 with a range of detected values from 120 to 220 µg/kg. Aroclor-1254 concentrations within Pond B-4 were greater than the threshold effect concentration, and below the mid-range effect concentration. Both in-situ bioassay results and tissue studies at the ponds indicate Aroclor-1254 does not appear to pose a risk to aquatic populations (DOE 1995).

PAHs were detected in Pond B-4 and in a portion of the SW AEU that overlaps with the IA. No PAHs were detected in Pond B-5 indicating these chemicals may be limited to the portions of the drainage within the IA. Literature-derived toxicity thresholds were obtained for the detected PAHs, and as noted in Appendix B, HQs calculated with these thresholds indicate a low-to-moderate risk potential for Pond B-4 and the SW AEU. Appendix B provides additional details of this analysis.

5.5 Woman Creek Aquatic Exposure Unit

Several inorganics and SVOCs, and one PCB, listed below, were detected in sediment and carried through the ECOPC process for WC AEU sediment.

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Aluminum	4-Methylphenol
Antimony	Benzo(a)anthracene
Barium	Benzo(a)pyrene
Cadmium	Benzo(k)fluoranthene
Copper	Chrysene
Fluoride	Fluoranthene
Iron	Heptachlor
Lead	Aroclor-1254
Nickel	Phenanthrene
Selenium	Pyrene
Zinc	

Based on HQ calculations, antimony, fluoride, iron, zinc, heptachlor, 4-methylphenol, benzo(a)anthracene, benzo(a)pyrene, chrysene, Aroclor-1254, phenanthrene, and pyrene required further evaluation. These ECOPCs were further evaluated spatially. Depositional trends were not evident for antimony, iron, or heptachlor and these ECOPCs were eliminated from consideration. Fluoride, 4-methylphenol, benzo(a)anthracene, benzo(a)pyrene, chrysene, Aroclor-1254, phenanthrene, and pyrene were only detected in the SID or the area of the WC AEU that overlapped the IA and were eliminated from consideration because aquatic habitat is very limited in this area. There are no values of concern for Aroclor-1254 within the pond areas. Zinc was detected at concentrations greater than the ESL, yet below the toxicity threshold. Zinc occurs in areas north, within, and south of the IA and appears to occur naturally at these levels. Zinc is not concentrated in any single location (such as Pond C-2) and would, therefore, not pose a risk to an isolated population of aquatic receptors. As such, zinc was eliminated from consideration. Appendix C provides additional details of this analysis.

6.0 NFAA SUMMARY

Based on analytical results, the SSRS, and the ecological screen, action is not required, and an NFAA determination is justified for IHSS Group NE-1 given the following:

- Activities and concentrations of COCs were uniformly below RFCA WRW ALs.
- Migration of soil or sediment contaminants to surface water is unlikely to impact water quality because little contamination is present. Routine surface water monitoring results indicate surface water standards are met and that pond sediments are not impacting surface water. The ponds are also configured to protect off-site water sources. Stormwater runoff is retained in the terminal ponds and sampled. If the surface water results meet applicable standards, the water is released. Erosion of the pond sediments because of a large influx of water (from a storm) is not likely because the ponds are currently and expected to remain as low-energy ponds and less water will be available after Site closure. Additionally, predictions of contaminant migration based on integration of the WEPP (USDA 1995) and HEC-6T (Thomas 1999) models are conservative. Site empirical data indicate contaminant migration is less than model predictions.

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- Contaminants originating in IHSS Group NE-1 soil and sediment are not likely to impact surface water via transport in groundwater because soil contamination levels in IHSS Group NE-1 are very low. Groundwater contamination present beneath IHSS Group NE-1 was evaluated as part of the Groundwater IM/IRA (DOE 2005c).

- Based on the ecological screen for the NW AEU, SW AEU, and WC AEU, removal of sediment to protect ecological receptors is not necessary.

Approval of this Data Summary Report constitutes regulatory agency concurrence that IHSSs NE-142.1, NE-142.2, NE-142.3, NE-142.4, NE-142.8, NE-142.9, SE-142.11, and NE-142.12 are NFAA Sites. This information and the NFAA determination will be documented in the FY05 HRR. Ecological factors will be further evaluated in the CRA.

7.0 DATA QUALITY ASSESSMENT

This Data Quality Assessment (DQA) was conducted in accordance with the IABZSAP (DOE 2004b) to describe the quality of data and its adherence to the data quality objectives (DQOs). DQOs for recent project data are described in the IABZSAP (DOE 2004b). DQOs for OU-specific data collection are described in the Final Phase I RFI/RI Work Plan for Walnut Creek Priority Drainage, Operable Unit 6 (DOE 1992). Only QC records associated with data included in this report are included in the DQA. All DQOs for this project were achieved based on the following:

- Regulatory agency-approved sampling program design (DOE 1992, 2004b, 2004c);

- Collection of samples in accordance with the sampling design; and

- Results of the DQA, as described in the following sections.

7.1 DQA Process

The DQA process ensures that the type, quantity, and quality of environmental data used in decision making are defensible, and is based on the following guidance and requirements:

- U.S. Environmental Protection Agency (EPA), 1994a, Guidance for the Data Quality Objective Process, QA/G-4;

- EPA, 1998, Guidance for the Data Quality Assessment Process, Practical Methods for Data Analysis, QA/G-9; and

- U.S. Department of Energy (DOE), 1999, Quality Assurance, Order 414.1A.

Verification and validation (V&V) of data are the primary components of the DQA. The final data are compared with original project DQOs and evaluated with respect to project decisions; uncertainty within the decisions; and quality criteria required for the data, specifically precision, accuracy, representativeness, completeness, comparability, and sensitivity (PARCCS). Validation criteria are consistent with the following RFETS-specific documents and industry guidelines:

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- EPA, 1994b, USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, 540/R-94/012;
- EPA, 1994c, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, 540/R-94/013;
- Kaiser-Hill Company, L.L.C. (K-H) V&V Guidelines:
  - General Guidelines for Data Verification and Validation, DA-GR01 v2, 2002a
  - V&V Guidelines for Isotopic Determinations by Alpha Spectrometry, DA-RC01 v2, 2002b
  - V&V Guidelines for Volatile Organics, DA-SS01 v3, 2002c
  - V&V Guidelines for Semivolatile Organics, DA-SS02 v3, 2002d
  - V&V Guidelines for Metals, DA-SS05 v3, 2002e; and
- Lockheed Martin, 1997, Evaluation of Radiochemical Data Usability, ES/ER/MS-5.

This report will be submitted to the Comprehensive Environmental Response, Compensation, and Liability Act (CERCLA) Administrative Record (AR) for permanent storage 30 days after being provided to the Colorado Department of Public Health and Environment (CDPHE) and/or EPA.

7.2 V&V of Results

Verification ensures that data produced and used by the project are documented and traceable in accordance with quality requirements. Validation consists of a technical review of all data that directly support the project decisions so that any limitations of the data relative to project goals are delineated and the associated data are qualified accordingly. The V&V process defines the criteria that constitute data quality, namely PARCCS parameters. Data traceability and archiving are also addressed. V&V criteria include the following:

- Chain-of-custody;
- Preservation and hold times;
- Instrument calibrations;
- Preparation blanks;
- Interference check samples (metals);
- Matrix spikes/matrix spike duplicates (MS/MSDs);
- Laboratory control samples (LCSs);

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- Field duplicate measurements;
- Chemical yield (radiochemistry);
- Required quantitation limits/minimum detectable activities (sensitivity of chemical and radiochemical measurements, respectively); and
- Sample analysis and preparation methods.

Evaluation of V&V criteria ensures that PARCCS parameters are satisfactory (that is, within tolerances acceptable to the project). Satisfactory V&V of laboratory quality controls are captured through application of validation "flags" or qualifiers to individual records.

Raw hard-copy data (for example, individual analytical data packages) are currently filed by report identification number (RIN) and maintained by K-H Analytical Services Division (ASD); older hard copies may reside in the Federal Center in Lakewood, Colorado. Electronic data are stored in the RFETS SWD.

Both real and QC data are included on the enclosed CD.

7.2.1 Accuracy

The following measures of accuracy were evaluated:

- LCSs;
- Surrogates;
- Field blanks; and
- Sample MSs.

Results are compared to method requirements and project goals. The results of these comparisons are summarized for RFCA COCs where the result could impact project decisions. Particular attention is paid to those values near ALs when QC results could indicate unacceptable levels of uncertainty for decision-making purposes.

LCS Evaluation

As indicated in Table 10, LCSs were not run for all test methods and laboratory batches in this project. Because samples included in this DQA were collected over a number of years and in accordance with several different programs, laboratory QC and quality assurance (QA) requirements were not consistent for all of the samples. When the In-Situ Counting System (ISOCS) technique is used for gamma spectroscopy, an internal standard approach is used instead of LCSs. The on-site laboratory that performs gamma spectroscopy is therefore not required to provide LCS data.

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Table 10
LCS Frequency

Test Method	Laboratory Batch	LCS Run?
ALPHA SPEC	130421	Yes
ALPHA SPEC	130422	Yes
ALPHA SPEC	130423	Yes
ALPHA SPEC	1650	Yes
ALPHA SPEC	1701	Yes
ALPHA SPEC	1862	Yes
ALPHA SPEC	1950	Yes
ALPHA SPEC	1997	Yes
ALPHA SPEC	2036	Yes
ALPHA SPEC	2150	Yes
ALPHA SPEC	2279	Yes
ALPHA SPEC	2285	Yes
ALPHA SPEC	2358	Yes
ALPHA SPEC	2378	Yes
ALPHA SPEC	4363290	Yes
ALPHA SPEC	4363293	Yes
ALPHA SPEC	4363295	Yes
ALPHA SPEC	4364318	Yes
ALPHA SPEC	4364321	Yes
ALPHA SPEC	4364322	Yes
ALPHA SPEC	5013310	Yes
ALPHA SPEC	5013312	Yes
ALPHA SPEC	5013313	Yes
ALPHA SPEC	5013459	Yes
ALPHA SPEC	5013460	Yes
ALPHA SPEC	5013461	Yes
CLP-SOW-TOTAL	97GI802	Yes
CLP-SOW-TOTAL	97HG094	Yes
EPA 624	00LVH396	Yes
EPA 624	00LVK001	Yes
EPA 624	00LVK202	Yes
EPA 624	00LVK300	Yes
EPA 624	01LVK165	Yes
EPA 624	01LVN126	Yes
EPA 624	242042801	Yes
SW-846 6010	4363216	Yes
SW-846 6010	4363604	Yes
SW-846 6010	4365400	Yes
SW-846 6010	5011405	Yes
SW-846 6010	5011407	Yes
SW-846 6010	5012189	Yes
SW-846 6010	5012317	Yes

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Test Method	Laboratory Batch	LCS Run?
SW-846 6010/6010B	130033	Yes
SW-846 6010/6010B	130037	Yes
SW-846 6010/6010B	130264	Yes
SW-846 6010/6010B	131022	Yes
SW-846 6010/6010B	131030	Yes
SW-846 6010/6010B	131089	Yes
SW-846 6010/6010B	131122	Yes
SW-846 6010/6010B	132307	Yes
SW-846 8082	4362441	Yes
SW-846 8082	4363589	Yes
SW-846 8260	131871	Yes
SW-846 8260	5004135	Yes
SW-846 8270	4364401	Yes
SW-846 8270B	00LE0229	Yes

The minimum and maximum LCS results are tabulated by chemical for the entire project in Table 11. Most LCS recoveries were within tolerances except for one antimony result. The highest detection for antimony was nearly an order of magnitude below the WRW AL. No records were flagged for poor LCS recovery and no project decisions were affected.

Table 11
LCS Evaluation Summary

Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
SW-846 8260	71-55-6	1,1,1-Trichloroethane	93	93
SW-846 8260	79-34-5	1,1,2,2-Tetrachloroethane	104	104
SW-846 8260	79-00-5	1,1,2-Trichloroethane	96	96
SW-846 8260	75-34-3	1,1-Dichloroethane	88	88
SW-846 8260	75-35-4	1,1-Dichloroethene	93	105
SW-846 8260	120-82-1	1,2,4-Trichlorobenzene	97	97
SW-846 8270	120-82-1	1,2,4-Trichlorobenzene	71	71
SW-846 8260	95-50-1	1,2-Dichlorobenzene	93	93
SW-846 8260	107-06-2	1,2-Dichloroethane	87	87
SW-846 8260	78-87-5	1,2-Dichloropropane	88	88
SW-846 8260	106-46-7	1,4-Dichlorobenzene	96	96
SW-846 8270	95-95-4	2,4,5-Trichlorophenol	70	70
SW-846 8270	88-06-2	2,4,6-Trichlorophenol	64	64
SW-846 8270	120-83-2	2,4-Dichlorophenol	68	68
SW-846 8270	105-67-9	2,4-Dimethylphenol	66	66
SW-846 8270	51-28-5	2,4-Dinitrophenol	53	53
SW-846 8270	121-14-2	2,4-Dinitrotoluene	73	73
SW-846 8270	606-20-2	2,6-Dinitrotoluene	64	64
SW-846 8260	78-93-3	2-Butanone	93	93

Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
SW-846 8270	91-58-7	2-Chloronaphthalene	66	66
SW-846 8270	95-57-8	2-Chlorophenol	72	72
SW-846 8270	91-57-6	2-Methylnaphthalene	72	72
SW-846 8270	95-48-7	2-Methylphenol	68	68
SW-846 8270	88-74-4	2-Nitroaniline	63	63
SW-846 8270	91-94-1	3,3'-Dichlorobenzidine	60	60
SW-846 8270	534-52-1	4,6-Dinitro-2-methylphenol	62	62
SW-846 8270	106-47-8	4-Chloroaniline	56	56
SW-846 8260	108-10-1	4-Methyl-2-pentanone	95	95
SW-846 8270	106-44-5	4-Methylphenol	71	71
SW-846 8270	100-02-7	4-Nitrophenol	66	66
SW-846 8270	83-32-9	Acenaphthene	66	66
SW-846 8260	67-64-1	Acetone	93	93
SW-846 6010/6010B	7429-90-5	Aluminum	109.1	114.4
CLP-SOW-TOTAL	7429-90-5	Aluminum	92.6	92.6
SW-846 6010	7429-90-5	Aluminum	95	99
ALPHA SPEC	14596-10-2	Americium-241	109	115
SW-846 8270	120-12-7	Anthracene	68	68
SW-846 6010/6010B	7440-36-0	Antimony	66.7	75.6
SW-846 6010	7440-36-0	Antimony	90	92
CLP-SOW-TOTAL	7440-36-0	Antimony	91	91
SW-846 8082	12674-11-2	Aroclor-1016	82	94
SW-846 8082	11096-82-5	Aroclor-1260	73	98
SW-846 6010/6010B	7440-38-2	Arsenic	100.8	100.8
CLP-SOW-TOTAL	7440-38-2	Arsenic	91.3	91.3
SW-846 6010	7440-38-2	Arsenic	90	90
SW-846 6010	7440-39-3	Barium	98	99
CLP-SOW-TOTAL	7440-39-3	Barium	88.7	88.7
SW-846 6010/6010B	7440-39-3	Barium	98.6	104.6
SW-846 8260	71-43-2	Benzene	85	93
SW-846 8270	56-55-3	Benzo(a)anthracene	64	64
SW-846 8270	50-32-8	Benzo(a)pyrene	64	64
SW-846 8270	205-99-2	Benzo(b)fluoranthene	64	64
SW-846 8270	207-08-9	Benzo(k)fluoranthene	65	65
SW-846 8270	65-85-0	Benzoic Acid	39	39
SW-846 8270	100-51-6	Benzyl Alcohol	63	63
SW-846 6010/6010B	7440-41-7	Beryllium	83.1	89.3
CLP-SOW-TOTAL	7440-41-7	Beryllium	90.1	90.1
SW-846 6010	7440-41-7	Beryllium	99	101
SW-846 8270	111-44-4	bis(2-Chloroethyl)ether	68	68
SW-846 8270	39638-32-9	bis(2-Chloroisopropyl)ether	73	73
SW-846 8270	117-81-7	bis(2-Ethylhexyl)phthalate	65	65
SW-846 8260	75-27-4	Bromodichloromethane	90	90

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Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
SW-846 8260	75-25-2	Bromoform	101	101
SW-846 8260	74-83-9	Bromomethane	97	97
SW-846 8270	85-68-7	Butylbenzylphthalate	68	68
SW-846 6010	7440-43-9	Cadmium	92	95
CLP-SOW-TOTAL	7440-43-9	Cadmium	92	92
SW-846 6010/6010B	7440-43-9	Cadmium	91.2	98.4
SW-846 8260	75-15-0	Carbon Disulfide	75	75
SW-846 8260	56-23-5	Carbon Tetrachloride	93	93
SW-846 8260	108-90-7	Chlorobenzene	94	97
SW-846 8260	75-00-3	Chloroethane	95	95
SW-846 8260	67-66-3	Chloroform	91	91
SW-846 8260	74-87-3	Chloromethane	94	94
SW-846 6010/6010B	7440-47-3	Chromium	102.8	104.9
CLP-SOW-TOTAL	7440-47-3	Chromium	92.9	92.9
SW-846 6010	7440-47-3	Chromium	94	97
SW-846 8270	218-01-9	Chrysene	63	63
SW-846 8260	10061-01-5	cis-1,3-Dichloropropene	93	93
SW-846 6010/6010B	7440-48-4	Cobalt	104.5	107.3
SW-846 6010	7440-48-4	Cobalt	91	94
CLP-SOW-TOTAL	7440-48-4	Cobalt	91.3	91.3
CLP-SOW-TOTAL	7440-50-8	Copper	89.3	89.3
SW-846 6010	7440-50-8	Copper	93	97
SW-846 6010/6010B	7440-50-8	Copper	99.3	109.2
SW-846 8270	84-74-2	Di-n-butylphthalate	70	70
SW-846 8270	117-84-0	Di-n-octylphthalate	65	65
SW-846 8270	53-70-3	Dibenz(a,h)anthracene	61	61
SW-846 8270	132-64-9	Dibenzofuran	70	70
SW-846 8260	124-48-1	Dibromochloromethane	95	95
SW-846 8270	84-66-2	Diethylphthalate	71	71
SW-846 8270	131-11-3	Dimethylphthalate	72	72
SW-846 8260	100-41-4	Ethylbenzene	100	100
SW-846 8270	206-44-0	Fluoranthene	71	71
SW-846 8270	86-73-7	Fluorene	66	66
SW-846 8270	118-74-1	Hexachlorobenzene	66	66
SW-846 8260	87-68-3	Hexachlorobutadiene	96	96
SW-846 8270	87-68-3	Hexachlorobutadiene	69	69
SW-846 8270	77-47-4	Hexachlorocyclopentadiene	69	69
SW-846 8270	67-72-1	Hexachloroethane	71	71
SW-846 8270	193-39-5	Indeno(1,2,3-cd)pyrene	62	62
SW-846 6010/6010B	7439-89-6	Iron	97.2	103.5
SW-846 6010	7439-89-6	Iron	97	106
CLP-SOW-TOTAL	7439-89-6	Iron	88.8	88.8
SW-846 8270	78-59-1	Isophorone	69	69

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Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
CLP-SOW-TOTAL	7439-92-1	Lead	92.8	92.8
SW-846 6010	7439-92-1	Lead	92	94
SW-846 6010/6010B	7439-92-1	Lead	95.3	95.8
SW-846 6010/6010B	7439-93-2	Lithium	96.9	97.1
SW-846 6010	7439-93-2	Lithium	97	102
CLP-SOW-TOTAL	7439-93-2	Lithium	105	105
CLP-SOW-TOTAL	7439-96-5	Manganese	89.8	89.8
SW-846 6010	7439-96-5	Manganese	96	98
SW-846 6010/6010B	7439-96-5	Manganese	103.4	104.9
SW-846 6010/6010B	7439-97-6	Mercury	87.1	91.1
SW-846 6010	7439-97-6	Mercury	93	101
CLP-SOW-TOTAL	7439-97-6	Mercury	107	107
SW-846 8260	75-09-2	Methylene chloride	93	93
CLP-SOW-TOTAL	7439-98-7	Molybdenum	90.8	90.8
SW-846 6010	7439-98-7	Molybdenum	92	95
SW-846 6010/6010B	7439-98-7	Molybdenum	100.9	104.4
SW-846 8270	86-30-6	n-Nitrosodiphenylamine	73	73
SW-846 8270	621-64-7	n-Nitrosodipropylamine	74	74
SW-846 8260	91-20-3	Naphthalene	95	95
SW-846 8270	91-20-3	Naphthalene	67	67
SW-846 6010/6010B	7440-02-0	Nickel	103.8	108.3
SW-846 6010	7440-02-0	Nickel	93	95
CLP-SOW-TOTAL	7440-02-0	Nickel	92.3	92.3
SW-846 8270	98-95-3	Nitrobenzene	68	68
SW-846 8270	87-86-5	Pentachlorophenol	63	63
SW-846 8270	108-95-2	Phenol	72	72
ALPHA SPEC	10-12-8	Plutonium-239/240	98	105
SW-846 8270	129-00-0	Pyrene	62	62
SW-846 6010/6010B	7782-49-2	Selenium	106.7	106.9
SW-846 6010	7782-49-2	Selenium	89	90
CLP-SOW-TOTAL	7782-49-2	Selenium	92.2	92.2
SW-846 6010/6010B	7440-22-4	Silver	110.4	116
CLP-SOW-TOTAL	7440-22-4	Silver	92.1	92.1
SW-846 6010	7440-22-4	Silver	96	96
SW-846 6010	7440-24-6	Strontium	96	97
CLP-SOW-TOTAL	7440-24-6	Strontium	90.3	90.3
SW-846 6010/6010B	7440-24-6	Strontium	102.5	110.9
SW-846 8260	100-42-5	Styrene	102	102
SW-846 8260	127-18-4	Tetrachloroethene	98	98
SW-846 6010/6010B	7440-31-5	Tin	98.3	99.3
CLP-SOW-TOTAL	7440-31-5	Tin	91.8	91.8
SW-846 6010	7440-31-5	Tin	91	92
SW-846 8260	108-88-3	Toluene	88	97

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Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
SW-846 8260	10061-02-6	trans-1,3-Dichloropropene	97	97
SW-846 8260	79-01-6	Trichloroethene	86	92
SW-846 6010	11-09-6	Uranium, Total	100	101
SW-846 6010/6010B	11-09-6	Uranium, Total	81.3	90.4
ALPHA SPEC	7440-61-1	Uranium-238	84	84
SW-846 6010/6010B	7440-62-2	Vanadium	98.7	108
SW-846 6010	7440-62-2	Vanadium	94	97
CLP-SOW-TOTAL	7440-62-2	Vanadium	100	100
SW-846 8260	75-01-4	Vinyl chloride	94	94
SW-846 8260	1330-20-7	Xylene	101	101
CLP-SOW-TOTAL	7440-66-6	Zinc	91.2	91.2
SW-846 6010	7440-66-6	Zinc	94	96
SW-846 6010/6010B	7440-66-6	Zinc	100.5	105.3
SW-846 6010	7782-49-2	Selenium	89	90

Surrogate Evaluation

The minimum and maximum surrogate results are tabulated by chemical for the IHSS Group NE-1 project in Table 12. Surrogates are added to every sample; therefore, surrogate recoveries impact individual samples only. Unacceptable surrogate recoveries can indicate potential matrix effects. Surrogate recoveries reported above 100 percent may indicate the actual sample results are less than reported. The latter case is environmentally conservative, thus no further action is needed. Therefore, only the lowest recoveries were evaluated. For VOCs, surrogate recoveries were good with 76 percent the minimum. For SVOCs, the lowest recoveries in this data set were 51 percent for both deuterated nitrobenzene and 2-fluorophenol. The samples with the lowest recoveries were not flagged during the V&V process; therefore, no project decisions were impacted.

Table 12
Surrogate Recovery Summary

Number of Samples	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
VOC Surrogate Recoveries				
27	460-00-4	4-Bromofluorobenzene	78	126
11	17060-07-0	Deuterated 1,2-dichloroethane	76	95
27	2037-26-5	Deuterated Toluene	92	118
SVOC Surrogate Recoveries				
9	321-60-8	2-Fluorobiphenyl	52	71
9	367-12-4	2-Fluorophenol	51	72
9	4165-60-0	Deuterated nitrobenzene	51	70
9	1718-51-0	p-Terphenyl-d14	53	75

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Field Blank Evaluation

Detections in field blank QA samples are listed in Table 13. Detectable amounts of contaminants within field blanks, indicating possible cross-contamination, are evaluated if the same contaminant is detected in the associated real samples. When the real result is less than 10 times the blank result for laboratory contaminants and 5 times the result for nonlaboratory contaminants, the real result is eliminated from consideration.

Table 13
Field QA Summary

Laboratory	CAS Number	Analyte	Sample QC Code	Detected Result	Result Unit
STLDEN	67-64-1	Acetone	RNS	4.1	ug/L
ITLSL	7429-90-5	Aluminum	RNS	48.8	ug/L
TMAS	7429-90-5	Aluminum	RNS	37.1	ug/L
SCTK	14596-10-2	Americium-241	RNS	0.0015	pCi/L
ITLR	14596-10-2	Americium-241	RNS	0.01934	pCi/L
LOCK	14596-10-2	Americium-241	RNS	0.0069	pCi/L
TMAN	14596-10-2	Americium-241	RNS	0.01	pCi/L
ITLSL	7440-36-0	Antimony	RNS	67.1	ug/L
ITLSL	7440-39-3	Barium	RNS	6.2	ug/L
LVLI	7440-39-3	Barium	RNS	0.64	ug/L
TMAS	7440-39-3	Barium	RNS	3.4	ug/L
TMAS	7440-39-3	Barium	RNS	1.8	ug/L
TMAS	7440-41-7	Beryllium	RNS	0.6	ug/L
ITLSL	117-81-7	bis(2-Ethylhexyl)phthalate	RNS	3	ug/L
TMAS	7440-43-9	Cadmium	RNS	1.6	ug/L
TMAS	7440-48-4	Cobalt	RNS	2.7	ug/L
TMAS	7440-50-8	Copper	RNS	3.9	ug/L
RFWG	84-74-2	Di-n-butylphthalate	RNS	1	ug/L
LVLI	7439-89-6	Iron	RNS	5.4	ug/L
TMAS	7439-89-6	Iron	RNS	40.7	ug/L
TMAS	7439-92-1	Lead	RNS	3.1	ug/L
TMAS	7439-92-1	Lead	RNS	2	ug/L
ITLSL	7439-92-1	Lead	RNS	3.9	ug/L
TMAS	7439-93-2	Lithium	RNS	3.4	ug/L
TMAS	7439-96-5	Manganese	RNS	5.4	ug/L
TMAS	7439-96-5	Manganese	RNS	7.2	ug/L
LVLI	7439-96-5	Manganese	RNS	2.1	ug/L
ITLSL	7439-96-5	Manganese	RNS	20.5	ug/L
TMAS	7439-98-7	Molybdenum	RNS	3.5	ug/L
TMAS	7440-02-0	Nickel	RNS	3.1	ug/L
SCTK	10-12-8	Plutonium-239/240	RNS	-0.002	pCi/L
ITLR	10-12-8	Plutonium-239/240	RNS	0.07513	pCi/L
ITLSL	7440-22-4	Silver	RNS	11.9	ug/L
LVLI	7440-24-6	Strontium	RNS	0.95	ug/L

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Laboratory	CAS Number	Analyte	Sample QC Code	Detected Result	Result Unit
TMAS	7440-24-6	Strontium	RNS	1.8	ug/L
TMAS	7440-24-6	Strontium	RNS	1.2	ug/L
TMAS	7440-31-5	Tin	RNS	8.6	ug/L
ITLSL	7440-31-5	Tin	RNS	42.5	ug/L
ITLR	11-08-5	Uranium-234	RNS	0.2667	pCi/L
LOCK	11-08-5	Uranium-234	RNS	0.3131	pCi/L
SCTK	11-08-5	Uranium-234	RNS	-0.486	pCi/L
SCTK	15117-96-1	Uranium-235	RNS	0.0432	pCi/L
LOCK	15117-96-1	Uranium-235	RNS	0.0639	pCi/L
ITLR	15117-96-1	Uranium-235	RNS	0.1307	pCi/L
ITLR	7440-61-1	Uranium-238	RNS	0.1457	pCi/L
LOCK	7440-61-1	Uranium-238	RNS	0.4107	pCi/L
SCTK	7440-61-1	Uranium-238	RNS	0.0864	pCi/L
ITLSL	7440-66-6	Zinc	RNS	98.1	ug/L
ITLSL	7440-66-6	Zinc	RNS	35.6	ug/L
TMAS	7440-66-6	Zinc	RNS	10.2	ug/L
TMAS	7440-66-6	Zinc	RNS	15.8	ug/L

Sample MS Evaluation

The minimum and maximum MS results for IHSS Group NE-1 are summarized by chemical in Table 14. According to the EPA data validation guidelines, if organic MS recoveries are low, the data reviewer may use the MS and MSD results in conjunction with other QC criteria. In this case, the LCS recoveries were checked. For organic compounds in this project, the lowest MS recovery was 35 percent for benzoic acid. All real results for these compounds were nondetects with detection limits orders of magnitude below WRW ALs. For the inorganic analytes in this project, the lowest recoveries were -2779.7 percent for iron and -105.1 percent for manganese. The large negative percent recovery is caused by the relatively high concentration of the analyte in the original sample. The results for iron and manganese in the original sample were an order of magnitude less than the WRW ALs. Project decisions were not impacted.

Table 14
Sample MS Evaluation Summary

Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
SW-846 8260	71-55-6	1,1,1-Trichloroethane	81	81
SW-846 8260	79-34-5	1,1,2,2-Tetrachloroethane	96	96
SW-846 8260	79-00-5	1,1,2-Trichloroethane	87	87
SW-846 8260	75-34-3	1,1-Dichloroethane	79	79
CLP-SOW MEDIUM LEVEL SOIL METHOD	75-35-4	1,1-Dichloroethene	93	93
SW-846 8260	75-35-4	1,1-Dichloroethene	78	90
BNACLP	120-82-1	1,2,4-Trichlorobenzene	59	59

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Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
SW-846 8260	120-82-1	1,2,4-Trichlorobenzene	66	66
SW-846 8270	120-82-1	1,2,4-Trichlorobenzene	57	57
SW-846 8260	95-50-1	1,2-Dichlorobenzene	80	80
SW-846 8260	107-06-2	1,2-Dichloroethane	81	81
SW-846 8260	78-87-5	1,2-Dichloropropane	81	81
BNACLP	106-46-7	1,4-Dichlorobenzene	57	57
SW-846 8260	106-46-7	1,4-Dichlorobenzene	80	80
SW-846 8270	95-95-4	2,4,5-Trichlorophenol	61	61
SW-846 8270	88-06-2	2,4,6-Trichlorophenol	57	57
SW-846 8270	120-83-2	2,4-Dichlorophenol	58	58
SW-846 8270	105-67-9	2,4-Dimethylphenol	57	57
SW-846 8270	51-28-5	2,4-Dinitrophenol	46	46
BNACLP	121-14-2	2,4-Dinitrotoluene	75	75
SW-846 8270	121-14-2	2,4-Dinitrotoluene	64	64
SW-846 8270	606-20-2	2,6-Dinitrotoluene	58	58
SW-846 8260	78-93-3	2-Butanone	77	77
SW-846 8270	91-58-7	2-Chloronaphthalene	56	56
BNACLP	95-57-8	2-Chlorophenol	71	71
SW-846 8270	95-57-8	2-Chlorophenol	59	59
SW-846 8270	91-57-6	2-Methylnaphthalene	60	60
SW-846 8270	95-48-7	2-Methylphenol	59	59
SW-846 8270	88-74-4	2-Nitroaniline	56	56
SW-846 8270	91-94-1	3,3'-Dichlorobenzidine	57	57
SW-846 8270	534-52-1	4,6-Dinitro-2-methylphenol	54	54
SW-846 8270	106-47-8	4-Chloroaniline	47	47
SW-846 8260	108-10-1	4-Methyl-2-pentanone	83	83
SW-846 8270	106-44-5	4-Methylphenol	61	61
BNACLP	100-02-7	4-Nitrophenol	36	36
SW-846 8270	100-02-7	4-Nitrophenol	59	59
SW-846 8270	83-32-9	Acenaphthene	57	57
SW-846 8260	67-64-1	Acetone	72	72
DSMETCLP	7429-90-5	Aluminum	96.1	96.1
SMETCLP	7429-90-5	Aluminum	101	101
SW-846 6010/6010B	7429-90-5	Aluminum	1906.6	2464.4
WQPL	7664-41-7	Ammonia	77	120
SW-846 8270	120-12-7	Anthracene	58	58
CLP-SOW-TOTAL	7440-36-0	Antimony	13.9	13.9
DSMETCLP	7440-36-0	Antimony	100	100
SMETCLP	7440-36-0	Antimony	99.1	99.1
SW-846 6010/6010B	7440-36-0	Antimony	26.1	32.5
SW-846 8082	12674-11-2	Aroclor-1016	97	97
PCB8080C	11097-69-1	Aroclor-1254	95	122
SW-846 8082	11096-82-5	Aroclor-1260	99	99

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Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
CLP-SOW-TOTAL	7440-38-2	Arsenic	78.6	78.6
DMETAA	7440-38-2	Arsenic	97.2	97.2
DSMETCLP	7440-38-2	Arsenic	113	113
METAA	7440-38-2	Arsenic	87.9	87.9
SMETCLP	7440-38-2	Arsenic	105	105
SW-846 6010/6010B	7440-38-2	Arsenic	85.2	88.9
CLP-SOW-TOTAL	7440-39-3	Barium	75.4	75.4
DSMETCLP	7440-39-3	Barium	97.2	97.2
SMETCLP	7440-39-3	Barium	97.8	97.8
SW-846 6010/6010B	7440-39-3	Barium	81.7	147.8
CLP-SOWMEDIUM LEVEL SOIL METHO	71-43-2	Benzene	90	90
SW-846 8260	71-43-2	Benzene	76	83
SW-846 8270	56-55-3	Benzo(a)anthracene	56	56
SW-846 8270	50-32-8	Benzo(a)pyrene	56	56
SW-846 8270	205-99-2	Benzo(b)fluoranthene	60	60
SW-846 8270	207-08-9	Benzo(k)fluoranthene	54	54
SW-846 8270	65-85-0	Benzoic Acid	35	35
SW-846 8270	100-51-6	Benzyl Alcohol	54	54
CLP-SOW-TOTAL	7440-41-7	Beryllium	78.7	78.7
DSMETCLP	7440-41-7	Beryllium	100	100
SMETCLP	7440-41-7	Beryllium	103	103
SW-846 6010/6010B	7440-41-7	Beryllium	95.3	96
SW-846 8270	111-44-4	bis(2-Chloroethyl)ether	56	56
SW-846 8270	39638-32-9	bis(2-Chloroisopropyl)ether	60	60
SW-846 8270	117-81-7	bis(2-Ethylhexyl)phthalate	58	58
SW-846 8260	75-27-4	Bromodichloromethane	83	83
SW-846 8260	75-25-2	Bromoform	86	86
SW-846 8260	74-83-9	Bromomethane	91	91
SW-846 8270	85-68-7	Butylbenzylphthalate	59	59
CLP-SOW-TOTAL	7440-43-9	Cadmium	80.7	80.7
DMETAA	7440-43-9	Cadmium	100	100
DSMETCLP	7440-43-9	Cadmium	109	109
METAA	7440-43-9	Cadmium	93.2	93.2
SMETCLP	7440-43-9	Cadmium	109	109
SW-846 6010/6010B	7440-43-9	Cadmium	94.5	97.3
SW-846 8260	75-15-0	Carbon Disulfide	67	67
SW-846 8260	56-23-5	Carbon Tetrachloride	79	79
CLP-SOWMEDIUM LEVEL SOIL METHO	108-90-7	Chlorobenzene	92	92
SW-846 8260	108-90-7	Chlorobenzene	78	87
SW-846 8260	75-00-3	Chloroethane	92	92
SW-846 8260	67-66-3	Chloroform	84	84

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Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
SW-846 8260	74-87-3	Chloromethane	91	91
CLP-SOW-TOTAL	7440-47-3	Chromium	83.9	83.9
DSMETCLP	7440-47-3	Chromium	101	101
SMETCLP	7440-47-3	Chromium	101	101
SW-846 6010/6010B	7440-47-3	Chromium	107.4	118.2
WQPL	7440-47-3	Chromium	89	105
SW-846 8270	218-01-9	Chrysene	54	54
SW-846 8260	10061-01-5	cis-1,3-Dichloropropene	82	82
CLP-SOW-TOTAL	7440-48-4	Cobalt	80	80
DSMETCLP	7440-48-4	Cobalt	98.2	98.2
SMETCLP	7440-48-4	Cobalt	98.5	98.5
SW-846 6010/6010B	7440-48-4	Cobalt	89.4	94.3
CLP-SOW-TOTAL	7440-50-8	Copper	80	80
DSMETCLP	7440-50-8	Copper	97.7	97.7
SMETCLP	7440-50-8	Copper	97.8	97.8
SW-846 6010/6010B	7440-50-8	Copper	89.9	90.8
WQPL	57-12-5	Cyanide	96.7	96.7
SW-846 8270	84-74-2	Di-n-butylphthalate	62	62
SW-846 8270	117-84-0	Di-n-octylphthalate	59	59
SW-846 8270	53-70-3	Dibenz(a,h)anthracene	54	54
SW-846 8270	132-64-9	Dibenzofuran	61	61
SW-846 8260	124-48-1	Dibromochloromethane	86	86
SW-846 8270	84-66-2	Diethylphthalate	64	64
SW-846 8270	131-11-3	Dimethylphthalate	62	62
SW-846 8260	100-41-4	Ethylbenzene	90	90
SW-846 8270	206-44-0	Fluoranthene	61	61
SW-846 8270	86-73-7	Fluorene	58	58
WQPL	16984-48-8	Fluoride	78	89
SW-846 8270	118-74-1	Hexachlorobenzene	57	57
SW-846 8260	87-68-3	Hexachlorobutadiene	64	64
SW-846 8270	87-68-3	Hexachlorobutadiene	56	56
SW-846 8270	77-47-4	Hexachlorocyclopentadiene	51	51
SW-846 8270	67-72-1	Hexachloroethane	56	56
SW-846 8270	193-39-5	Indeno(1,2,3-cd)pyrene	54	54
DSMETCLP	7439-89-6	Iron	102	102
SMETCLP	7439-89-6	Iron	103	103
SW-846 6010/6010B	7439-89-6	Iron	-2779.7	155.6
SW-846 8270	78-59-1	Isophorone	58	58
CLP-SOW-TOTAL	7439-92-1	Lead	79	79
DMETAA	7439-92-1	Lead	108	108
DSMETCLP	7439-92-1	Lead	105	105
METAA	7439-92-1	Lead	108	108
SMETCLP	7439-92-1	Lead	101	101

Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
SW-846 6010/6010B	7439-92-1	Lead	80.5	94.6
CLP-SOW-TOTAL	7439-93-2	Lithium	103	103
SW-846 6010/6010B	7439-93-2	Lithium	82.9	104.1
CLP-SOW-TOTAL	7439-96-5	Manganese	84.7	84.7
DMETAA	7439-96-5	Manganese	96.4	96.4
DSMETCLP	7439-96-5	Manganese	100	100
SMETCLP	7439-96-5	Manganese	100	100
SW-846 6010/6010B	7439-96-5	Manganese	-105.1	58.4
DMETAA	7439-97-6	Mercury	100	100
DSMETCLP	7439-97-6	Mercury	107	107
METAA	7439-97-6	Mercury	100	100
SMETCLP	7439-97-6	Mercury	117	117
SW-846 6010	7439-97-6	Mercury	93	93
SW-846 6010/6010B	7439-97-6	Mercury	92.2	94.9
SW-846 8260	75-09-2	Methylene chloride	81	81
CLP-SOW-TOTAL	7439-98-7	Molybdenum	70.8	70.8
SW-846 6010/6010B	7439-98-7	Molybdenum	83.3	84.1
SW-846 8270	86-30-6	n-Nitrosodiphenylamine	65	65
BNACLP	621-64-7	n-Nitrosodipropylamine	67	67
SW-846 8270	621-64-7	n-Nitrosodipropylamine	61	61
SW-846 8260	91-20-3	Naphthalene	64	64
SW-846 8270	91-20-3	Naphthalene	55	55
CLP-SOW-TOTAL	7440-02-0	Nickel	80.7	80.7
DSMETCLP	7440-02-0	Nickel	100	100
SMETCLP	7440-02-0	Nickel	101	101
SW-846 6010/6010B	7440-02-0	Nickel	84.4	90.7
WQPL	14797-55-8	Nitrate	102	116
WQPL	14797-65-0	Nitrite	84	111
SW-846 8270	98-95-3	Nitrobenzene	57	57
BNACLP	87-86-5	Pentachlorophenol	90	90
SW-846 8270	87-86-5	Pentachlorophenol	57	57
BNACLP	108-95-2	Phenol	34	34
SW-846 8270	108-95-2	Phenol	61	61
BNACLP	129-00-0	Pyrene	81	81
SW-846 8270	129-00-0	Pyrene	54	54
CLP-SOW-TOTAL	7782-49-2	Selenium	73.7	73.7
DMETAA	7782-49-2	Selenium	81.6	81.6
DSMETCLP	7782-49-2	Selenium	114	114
METAA	7782-49-2	Selenium	75.5	75.5
SMETCLP	7782-49-2	Selenium	106	106
SW-846 6010/6010B	7782-49-2	Selenium	83.5	89.5
CLP-SOW-TOTAL	7440-22-4	Silver	82.2	82.2
DMETAA	7440-22-4	Silver	97.3	97.3

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Test Method	CAS Number	Analyte	Minimum Percent Recovery	Maximum Percent Recovery
DSMETCLP	7440-22-4	Silver	93	93
METAA	7440-22-4	Silver	68.1	68.1
SMETCLP	7440-22-4	Silver	96.4	96.4
SW-846 6010/6010B	7440-22-4	Silver	91.8	100.3
CLP-SOW-TOTAL	7440-24-6	Strontium	79.5	79.5
SW-846 6010/6010B	7440-24-6	Strontium	92.6	120
SW-846 8260	100-42-5	Styrene	90	90
SW-846 8260	127-18-4	Tetrachloroethene	83	83
CLP-SOW-TOTAL	7440-31-5	Tin	65.1	65.1
SW-846 6010/6010B	7440-31-5	Tin	88.5	90.5
CLP-SOWMEDIUM LEVEL SOIL METHO	108-88-3	Toluene	95	95
SW-846 8260	108-88-3	Toluene	74	90
SW-846 8260	10061-02-6	trans-1,3-Dichloropropene	90	90
CLP-SOWMEDIUM LEVEL SOIL METHO	79-01-6	Trichloroethene	99	99
SW-846 8260	79-01-6	Trichloroethene	74	77
SW-846 6010/6010B	11-09-6	Uranium, Total	90.5	102.3
CLP-SOW-TOTAL	7440-62-2	Vanadium	93.4	93.4
DSMETCLP	7440-62-2	Vanadium	102	102
SMETCLP	7440-62-2	Vanadium	102	102
SW-846 6010/6010B	7440-62-2	Vanadium	124.1	133.2
SW-846 8260	75-01-4	Vinyl chloride	88	88
SW-846 8260	1330-20-7	Xylene	90	90
CLP-SOW-TOTAL	7440-66-6	Zinc	71	71
DSMETCLP	7440-66-6	Zinc	88.2	88.2
SMETCLP	7440-66-6	Zinc	96.9	96.9
SW-846 6010/6010B	7440-66-6	Zinc	48.8	82.9

7.2.2 Precision

Sample MSD Evaluation

Laboratory precision is measured through use of MSDs, as summarized in Table 15. Analytes with the highest relative percent differences (RPDs) were reviewed by comparing the highest sample result to the AL. If the highest sample results were sufficiently below the AL, no further action is needed. No project decisions were affected by MSD results.

Table 15
Sample MSD Evaluation Summary

Test Method	CAS Number	Analyte	Maximum RPDs
SW-846 8260	71-55-6	1,1,1-Trichloroethane	3.64
SW-846 8260	79-34-5	1,1,2,2-Tetrachloroethane	5.08
SW-846 8260	79-00-5	1,1,2-Trichloroethane	2.27

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Test Method	CAS Number	Analyte	Maximum RPDs
SW-846 8260	75-34-3	1,1-Dichloroethane	3.73
SW-846 8260	75-35-4	1,1-Dichloroethene	6.45
SW-846 8260	120-82-1	1,2,4-Trichlorobenzene	11.20
SW-846 8270	120-82-1	1,2,4-Trichlorobenzene	20.47
SW-846 8260	95-50-1	1,2-Dichlorobenzene	2.53
SW-846 8260	107-06-2	1,2-Dichloroethane	2.44
SW-846 8260	78-87-5	1,2-Dichloropropane	3.64
SW-846 8260	106-46-7	1,4-Dichlorobenzene	3.68
SW-846 8270	95-95-4	2,4,5-Trichlorophenol	13.74
SW-846 8270	88-06-2	2,4,6-Trichlorophenol	11.57
SW-846 8270	120-83-2	2,4-Dichlorophenol	14.40
SW-846 8270	105-67-9	2,4-Dimethylphenol	17.60
SW-846 8270	51-28-5	2,4-Dinitrophenol	21.36
SW-846 8270	121-14-2	2,4-Dinitrotoluene	13.14
SW-846 8270	606-20-2	2,6-Dinitrotoluene	14.40
SW-846 8260	78-93-3	2-Butanone	9.88
SW-846 8270	91-58-7	2-Chloronaphthalene	17.89
SW-846 8270	95-57-8	2-Chlorophenol	17.05
SW-846 8270	91-57-6	2-Methylnaphthalene	18.18
SW-846 8270	95-48-7	2-Methylphenol	15.63
SW-846 8270	88-74-4	2-Nitroaniline	16.39
SW-846 8270	91-94-1	3,3'-Dichlorobenzidine	10.00
SW-846 8270	534-52-1	4,6-Dinitro-2-methylphenol	15.38
SW-846 8270	106-47-8	4-Chloroaniline	13.86
SW-846 8260	108-10-1	4-Methyl-2-pentanone	6.98
SW-846 8270	106-44-5	4-Methylphenol	16.54
SW-846 8270	100-02-7	4-Nitrophenol	15.63
SW-846 8270	83-32-9	Acenaphthene	16.13
SW-846 8260	67-64-1	Acetone	6.71
SW-846 8270	120-12-7	Anthracene	17.32
SW-846 8082	12674-11-2	Aroclor-1016	0.00
SW-846 8082	11096-82-5	Aroclor-1260	18.78
SW-846 8260	71-43-2	Benzene	8.81
SW-846 8270	56-55-3	Benzo(a)anthracene	13.33
SW-846 8270	50-32-8	Benzo(a)pyrene	14.88
SW-846 8270	205-99-2	Benzo(b)fluoranthene	12.50
SW-846 8270	207-08-9	Benzo(k)fluoranthene	18.49
SW-846 8270	65-85-0	Benzoic Acid	15.79
SW-846 8270	100-51-6	Benzyl Alcohol	15.38
SW-846 8270	111-44-4	bis(2-Chloroethyl)ether	19.35
SW-846 8270	39638-32-9	bis(2-Chloroisopropyl)ether	19.55
SW-846 8270	117-81-7	bis(2-Ethylhexyl)phthalate	14.40
SW-846 8260	75-27-4	Bromodichloromethane	2.38
SW-846 8260	75-25-2	Bromoform	2.30

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Test Method	CAS Number	Analyte	Maximum RPDs
SW-846 8260	74-83-9	Bromomethane	2.17
SW-846 8270	85-68-7	Butylbenzylphthalate	15.63
SW-846 8260	75-15-0	Carbon Disulfide	1.50
SW-846 8260	56-23-5	Carbon Tetrachloride	4.94
SW-846 8260	108-90-7	Chlorobenzene	9.76
SW-846 8260	75-00-3	Chloroethane	1.08
SW-846 8260	67-66-3	Chloroform	2.35
SW-846 8260	74-87-3	Chloromethane	1.09
SW-846 8270	218-01-9	Chrysene	13.79
SW-846 8260	10061-01-5	cis-1,3-Dichloropropene	1.21
SW-846 8270	84-74-2	Di-n-butylphthalate	14.93
SW-846 8270	117-84-0	Di-n-octylphthalate	15.63
SW-846 8270	53-70-3	Dibenz(a,h)anthracene	13.79
SW-846 8270	132-64-9	Dibenzofuran	13.74
SW-846 8260	124-48-1	Dibromochloromethane	1.16
SW-846 8270	84-66-2	Diethylphthalate	13.14
SW-846 8270	131-11-3	Dimethylphthalate	14.93
SW-846 8260	100-41-4	Ethylbenzene	1.10
SW-846 8270	206-44-0	Fluoranthene	16.54
SW-846 8270	86-73-7	Fluorene	15.87
SW-846 8270	118-74-1	Hexachlorobenzene	14.63
SW-846 8270	87-68-3	Hexachlorobutadiene	19.35
SW-846 8260	87-68-3	Hexachlorobutadiene	24.56
SW-846 8270	77-47-4	Hexachlorocyclopentadiene	22.61
SW-846 8270	67-72-1	Hexachloroethane	19.35
SW-846 8270	193-39-5	Indeno(1,2,3-cd)pyrene	13.79
SW-846 8270	78-59-1	Isophorone	20.16
SW-846 6010	7439-97-6	Mercury	1.08
SW-846 8260	75-09-2	Methylene chloride	1.23
SW-846 8270	86-30-6	n-Nitrosodiphenylamine	14.29
SW-846 8270	621-64-7	n-Nitrosodipropylamine	19.26
SW-846 8270	91-20-3	Naphthalene	18.18
SW-846 8260	91-20-3	Naphthalene	1.57
SW-846 8270	98-95-3	Nitrobenzene	17.60
SW-846 8270	87-86-5	Pentachlorophenol	14.63
SW-846 8270	108-95-2	Phenol	13.74
SW-846 8270	129-00-0	Pyrene	15.38
SW-846 8260	100-42-5	Styrene	3.39
SW-846 8260	127-18-4	Tetrachloroethene	1.20
SW-846 8260	108-88-3	Toluene	7.79
SW-846 8260	10061-02-6	trans-1,3-Dichloropropene	1.10
SW-846 8260	79-01-6	Trichloroethene	10.26
SW-846 8260	75-01-4	Vinyl chloride	1.13
SW-846 8260	1330-20-7	Xylene	1.12

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Field Duplicate Evaluation

Field duplicate results reflect sampling precision, or overall repeatability of the sampling process. Current IABZSAP DQOs indicate the frequency of field duplicate collection should exceed 1 field duplicate per 20 real samples, or 5 percent. This goal is applied to the overall Environmental Restoration (ER) project and not on a specific IHSS Group basis. Table 16 indicates duplicate sampling frequencies were less than 5 percent for all methods. Because samples included in this DQA were collected over a number of years and in accordance with several different programs, field duplicate requirements were not consistent for all samples.

Table 16
Field Duplicate Sample Frequency Summary

Test Method	No. of Real Samples	No. of Duplicate Samples	% Duplicate Samples
ALPHA SPEC	199	5	2.51%
BNACLP	135	4	2.96%
CLHERB615	23	0	0.00%
CLP-SOW-TOTAL	2	0	0.00%
CLP-SOW MEDIUM LEVEL SOIL METHOD	2	0	0.00%
DHSLMET	19	0	0.00%
DIOX613	29	0	0.00%
DMETAA	5	0	0.00%
DMETADD	53	0	0.00%
DMETCLP	37	1	2.70%
DRADS	88	1	1.14%
DSMETCLP	99	0	0.00%
DWQPL	13	0	0.00%
EPA 160.2	1	0	0.00%
EPA 300.0	1	0	0.00%
EPA 353.1	1	0	0.00%
GAS PROPORTIONAL COUNTER	5	0	0.00%
HERB8150	53	0	0.00%
HSLMET	27	1	3.70%
LIQUID SCINTILLATION COUNTER	103	4	3.88%
METAA	6	0	0.00%
METADD	88	5	5.68%
METCLP	45	3	6.67%
PCB8080C	20	0	0.00%
PEST608	1	0	0.00%
PEST8140	1	0	0.00%
PESTCLP	106	3	2.83%
PHPEST610	26	0	0.00%
SMETCLP	260	11	4.23%

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Test Method	No. of Real Samples	No. of Duplicate Samples	% Duplicate Samples
SW-846 6010	10	0	0.00%
SW-846 6010/6010B	16	0	0.00%
SW-846 8082	9	0	0.00%
SW-846 8260	25	0	0.00%
SW-846 8270	9	0	0.00%
SW-846 8290	9	0	0.00%
TRADS	1177	36	3.06%
TRIPES507	1	0	0.00%
TRIPES619	110	0	0.00%
USGS/ALTERNATE	12	0	0.00%
VOA502.2	50	0	0.00%
VOA524.2	25	0	0.00%
VOACLP	148	5	3.38%
WQPL	888	28	3.15%

The RPDs shown in Table 17, indicate how much variation exists in the field duplicate analyses. The EPA data validation guidelines state that "there are no required review criteria for field duplicate analyses comparability." For the DQA, the highest RPDs were reviewed. The highest sample concentrations for those analytes were corrected for the associated RPD and the resulting numbers were compared to the ALs. For this project, decisions were not impacted.

Table 17
Field Duplicate RPD Evaluation Summary

Test Method	Analyte	Maximum RPDs
VOACLP	2-Butanone	104.00
DMETCLP	Aluminum	48.72
HSLMET	Aluminum	5.97
METCLP	Aluminum	6.30
SMETCLP	Aluminum	22.72
TRADS	Americium-241	48.72
PESTCLP	Aroclor-1254	12.12
SMETCLP	Arsenic	17.65
DMETCLP	Barium	2.61
HSLMET	Barium	0.14
METCLP	Barium	0.00
SMETCLP	Barium	6.61
BNACLP	Benzo(a)anthracene	16.22
BNACLP	Benzo(a)pyrene	14.63
BNACLP	Benzo(b)fluoranthene	22.22
BNACLP	Benzo(k)fluoranthene	30.77
BNACLP	Benzoic Acid	33.33
BNACLP	bis(2-Ethylhexyl)phthalate	51.55

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Test Method	Analyte	Maximum RPDs
SMETCLP	Chromium	30.71
BNACLP	Chrysene	16.67
METCLP	Cobalt	33.33
SMETCLP	Cobalt	16.11
HSLMET	Copper	39.25
METCLP	Copper	13.33
SMETCLP	Copper	8.44
BNACLP	Di-n-octylphthalate	76.19
BNACLP	Fluoranthene	26.80
DMETCLP	Iron	21.71
HSLMET	Iron	4.75
METCLP	Iron	57.67
SMETCLP	Iron	6.68
HSLMET	Lead	55.76
METCLP	Lead	101.59
SMETCLP	Lead	28.07
DMETCLP	Lithium	1.85
METADD	Lithium	14.69
METCLP	Lithium	8.37
DMETCLP	Manganese	13.48
HSLMET	Manganese	2.82
METCLP	Manganese	1.00
SMETCLP	Manganese	9.61
SMETCLP	Mercury	15.38
DMETCLP	Molybdenum	36.73
METCLP	Molybdenum	21.62
DMETCLP	Nickel	35.29
METCLP	Nickel	6.74
SMETCLP	Nickel	11.93
WQPL	Nitrate	22.22
TRADS	Plutonium-239/240	97.82
BNACLP	Pyrene	19.35
DMETCLP	Strontium	0.78
HSLMET	Strontium	1.17
METADD	Strontium	10.18
METCLP	Strontium	0.00
VOACLP	Toluene	123.81
DRADS	Uranium-234	11.76
TRADS	Uranium-234	199.10
TRADS	Uranium-235	233.50
DRADS	Uranium-238	14.69
TRADS	Uranium-238	157.28
METCLP	Vanadium	26.09
SMETCLP	Vanadium	12.61

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Test Method	Analyte	Maximum RPDs
HSLMET	Zinc	69.79
METCLP	Zinc	38.53
SMETCLP	Zinc	7.73

7.2.3 Completeness

Based on IABZSAP DQOs, a minimum of 25 percent of ER Program analytical (and radiological) results must be formally verified and validated. Of that percentage, no more than 10 percent of the results may be rejected, which ensures that analytical laboratory practices are consistent with quality requirements. These goals are applied to the overall ER project and not on a specific IHSS Group basis. Table 18 presents the number and percentage of validated records (codes without "1"), the number and percentage of verified records (codes with "1"), and the percentage of rejected records for each analytical method. For this project, the data were analyzed over a long period, and similar analyses were reported with different method names. For ease of review, these different methods were combined.

7.2.4 Sensitivity

RLs, in units of µg/kg for organics, milligrams per kilogram (mg/kg) for metals, and pCi/g for radionuclides, were compared with RFCA WRW ALs. Adequate sensitivities of analytical methods were attained for all COCs that affect project decisions. "Adequate" sensitivity is defined as an RL less than an analyte's associated AL, typically less than one-half the AL.

7.3 Summary of Data Quality

Out of 31,231 total records, 25,240 were validated and 2,303 were verified. Five hundred and forty one records were rejected. If additional V&V information is received, IHSS Group NE-1 records will be updated in SWD. Data qualified as a result of additional data will be assessed as part of the CRA process. Data collected and used for IHSS Group NE-1 are adequate for decision making based on ER Program goals.

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Table 18
Validation and Verification Summary

Validation Qualifier Code	Total of CAS Number	No. of Dissolved Metal Records	No. of Total Metal Records	No. of Pesticides/PCB Records	No. of Dissolved Radionuclide Recordss	No. of Total Radionuclide Records	No. of SVOC Records	No. of VOC Records	No. of Wet Chemistry Records
No V&V	3688	622	606	106	0	142	1026	964	222
1	14	0	12	0	0	2	0	0	0
A	581	0	0	9	149	310	90	23	0
J	1913	568	861	8	8	14	161	278	15
J1	206	0	173	0	0	29	0	4	0
JB	26	0	0	0	0	0	0	26	0
JB1	9	0	0	0	0	0	0	9	0
NJ	1	0	0	0	0	1	0	0	0
NJ1	5	0	0	0	0	5	0	0	0
R	521	41	48	39	12	91	179	89	22
R1	20	0	8	0	0	12	0	0	0
UJ	48	0	0	0	0	0	0	48	0
UJ1	99	0	45	0	0	0	0	54	0
V	9782	1094	1411	1019	119	273	3182	2572	112
V1	1950	0	404	63	0	700	468	315	0
Y	24	0	18	0	0	0	0	0	6
Z	12344	1059	871	1835	115	1566	2707	3734	457
Total	31231	3384	4457	3079	403	3145	7813	8116	834
Validated	25240	2762	3209	2910	403	2255	6319	6770	612
% Validated	80.82%	81.62%	72.00%	94.51%	100.00%	71.70%	80.88%	83.42%	73.38%
Verified	2303	0	642	63	0	748	468	382	0
% Verified	7.37%	0.00%	14.40%	2.05%	0.00%	23.78%	5.99%	4.71%	0.00%
Rejected	541	41	56	39	12	103	179	89	22
% Rejected	1.73%	1.21%	1.26%	1.27%	2.98%	3.28%	2.29%	1.10%	2.64%

8.0 REFERENCES

DOE, 1992, Phase I RFI/RI Work Plan for Walnut Creek Priority Drainage, Operable Unit 6, Rocky Flats Plant, Golden, Colorado, June.

DOE, 1992-2004, Historical Release Reports for the Rocky Flats Plant, Golden, Colorado, September.

DOE, 1995, Final Phase 1 RFI/RI Report, Woman Creek Priority Drainage, Operable Unit 5, Appendix N, Ecological Risk Assessment for Walnut Creek and Woman Creek Watersheds at the Rocky Flats Environmental Technology Site, Golden, Colorado, September

DOE, 1999, Order 414.1A, Quality Assurance.

DOE, 2003, Data Summary Report IHSS Group NE/NW, Rocky Flats Environmental Technology Site, Golden, Colorado, October.

DOE, 2004a, No Further Accelerated Action Justification for Retention Pond C-1, Rocky Flats Environmental Technology Site, Golden, Colorado, April.

DOE, 2004b, Industrial Area and Buffer Zone Sampling and Analysis Plan, Modification 1, Rocky Flats Environmental Technology Site, Golden, Colorado, May.DOE, 2004c, Comprehensive Risk Assessment SAP Addendum #05-01 – Phase 2 Targeted Sampling, Rocky Flats Environmental Technology Site, Golden, Colorado.

DOE, 2004d, Comprehensive Risk Assessment Work Plan and Methodology, Rocky Flats Environmental Technology Site, Golden, Colorado, September.

DOE, 2005a, Closeout Report for Ponds B-1, B-2, and B-3, Rocky Flats Environmental Technology Site, Golden, Colorado, May.

DOE, 2005b, Closeout Report for IHSS Group NE-1, Potential Area of Concern (PAC) NW-1505, North Firing Range, Rocky Flats Environmental Technology Site, Golden, Colorado (in review).

DOE, 2005c, Groundwater Interim Measure/Interim Remedial Action, Rocky Flats Environmental Technology Site, Golden, Colorado, May.

DOE, CDPHE, and EPA, 2003, Rocky Flats Cleanup Agreement Modification, Rocky Flats Environmental Technology Site, Golden, Colorado, June.

EPA, 1994a, Guidance for the Data Quality Objective Process, QA/G-4.

EPA, 1994b, USEPA Contract Laboratory Program National Functional Guidelines for Organic Data Review, 540/R-94/012.

EPA, 1994c, USEPA Contract Laboratory Program National Functional Guidelines for Inorganic Data Review, 540/R-94/013.

EPA, 1998, Guidance for the Data Quality Assessment Process, Practical Methods for Data Analysis, QA/G-9.

EPA and CDPHE, 1999, Correspondence to J. Legare, DOE RFO, from T. Rehder, EPA Region VIII, S. Gunderson, CDPHE, RE: 1997, Annual HRR Review , July 9, 1999.

K-H, 2002a, General Guidelines for Data Verification and Validation, DA-GR01 v2, October.

K-H, 2002b, V&V Guidelines for Isotopic Determinations by Alpha Spectrometry, DA-RC01 v2, October.

K-H, 2002c, V&V Guidelines for Volatile Organics, DA-SS01 v3, October.

K-H, 2002d, V&V Guidelines for Semivolatile Organics, DA-SS02 v3, October.

K-H, 2002e, V&V Guidelines for Metals, DA-SS05 v3, October.

Lockheed Martin, 1997, Evaluation of Radiochemical Data Usability, ES/ER/MS-5

Thomas, W.A., 1999, Sedimentation in Stream Networks (HEC-6T), Mobile Boundary Hydraulics, Clinton, Mississippi.

USDA, 1995, Water Erosion Prediction Project Hillslope Profile and Watershed Model Documentation, NERSL Report No. 10, Flanigan, D.C., M.A. Nearing and J.M.Laflin, eds, USDA-ARS National Soil Erosion Research Laboratory, West Lafayette, Indiana.

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Enclosure

Compact Disc Containing Standardized Real and QC Data

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APPENDIX A

ECOLOGICAL SCREENING SUMMARY
FOR THE NORTH WALNUT CREEK AQUATIC EXPOSURE UNIT

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ACRONYMS AND ABBREVIATIONS

ac-ft	acre-feet
AETA	apparent effects threshold approach
AEU	Aquatic Exposure Unit
AWQC	ambient water quality criteria
BKG	background
BZ	Buffer Zone
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EEC	extreme effects ocncentration
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ERL	effect range low
ERM	effect range medium
ESL	ecological screening level
EU	Exposure Unit
HQ	hazard quotient
IA	Industrial Area
IABZSAP	Industrial Area Buffer Zone Sampling and Analysis Plan
IHSS	Individual Hazardous Substance Site
LOAEL	lowest observed adverse effect level
μ/kg	micrograms per kilogram (may be found as ug/kg)
MDC	maximum detected concentration
MEC	mid-range effect concentration
mg/kg	milligrams per kilogram
NA	not applicable
NOAEL	no observed adverse effect level
NW AEU	North Walnut Creek Aquatic Exposure Unit
OU	Operable Unit
PAETA	potential apparent effects threshold approach
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
PEL	probable effect level
RFETS or Site	Rocky Flats Environmental Technology Site
SAP	Sampling and Analysis Plan
TEL	threshold effect level
TNRCC	Texas Natural Resource Conservation Commission
UCL	upper confidence limit
UTL	upper tolerance limit
VOC	volatile organic compound
WQCC	Water Quality Control Commission

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1.0 INTRODUCTION AND SITE SETTING

The purpose of this appendix is to provide a summary of potential ecological risk for the Individual Hazardous Substance Site (IHSS) Group NE-1 areas of interest (Ponds A-1, A-2, A-3, and A-4) for the North Walnut Creek Aquatic Exposure Unit (AEU) (NW AEU). In order to accomplish this task, the Comprehensive Risk Assessment (CRA) Methodology (DOE 2004a) was followed, in which the NW AEU was evaluated for the entire AEU. Through this process ecological contaminants of potential concern (ECOPCs) are identified and their locations within the drainage are determined. As such, this process focuses on any contaminants of potential concern that would occur in these ponds, while following the drainage-wide approach that focuses on the ecological endpoint of protecting aquatic populations throughout the AEU.

This appendix summarizes the identification process for ECOPCs, described in the CRA Methodology (DOE 2004a), that could pose a risk to aquatic receptors if all materials associated with the NW AEU were left in place. This appendix represents a component of work outlined within the Industrial Area (IA) and Buffer Zone (BZ) Sampling and Analysis Plan (SAP) (IABZSAP) Appendix D (DOE 2004b), which addresses the accelerated action process. A complete assessment of risk will be provided in Volume 15 of the CRA.

For the ECOPCs, standard risk characterization techniques were applied to determine which of the ECOPCs have the potential to cause risk to the population of aquatic receptors in the North Walnut Creek drainage. Further analysis techniques, such as frequency of detection and spatial extent and results of other studies were also included as additional lines of evidence. Section 2.0 provides a summary of the ECOPC process, and conclusions are summarized in Section 3.0.

The NW AEU encompasses the watershed components associated with the North Walnut Creek drainage. Runoff from the northern portion of the IA flows into North Walnut Creek, which has a series of retention ponds (Ponds A-1, A-2, A-3, and A-4) (Figure 2 of the Data Summary Report). Pond A-4 is the terminal pond and the downstream pond, Pond A-5, receives water from several creeks as well as North Walnut Creek. The Colorado Water Quality Control Commission (WQCC) classifies North Walnut Creek upstream of Pond A-4 as stream Segment 5 in the Big Dry Creek basin. North Walnut Creek has continuous flow at approximately 150 acre-feet (ac-ft) per year. These flows are likely to diminish with the removal of buildings and pavement from the IA, which will significantly reduce the volumes and peak discharge rates of runoff. Pond A-1 is isolated from North Walnut Creek by design and does not receive runoff from the IA. Historically, it was held in reserve to catch runoff in the event of a hazardous substance spill in the northern portion of the IA.

Fathead minnows (*Pimephales promelas*), a native species, are present in the A-series ponds and are the dominant fish species found in this AEU. A variety of non-native fish species (rainbow trout [*Salmo Gairdneri*], carp [*Cyprinus carpio*], and bass [*Micropterus sp.*]) were inadvertently introduced into the Walnut Creek ponds, although these introductions have not resulted in established reproducing fish populations. Golden shiners (*Notemigonus crysoleucas*), a non-native fish, are also present in the A ponds.

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Within the Walnut Creek area, the most common aquatic macroinvertebrates are the larvae of the blackfly (*Order Diptera, Simulidae* sp.), midge (*Order Diptera, Chironomidae sp*), mayfly (*Order Ephemeroptera*) (DOE, 1997), and scuds (*Hyallela azteca*) (DOE 2003). Other species include caddisflies (*Order Trichoptera*), craneflies (*Tipulidae sp.*), and damselfly larvae (*Order Odonata*), as well as snails (*Class Gastropoda*) and other amphipods (*Order Amphipoda*). Large macroinvertebrates, such as crayfish (*Order Decapoda, Family Astacidae*) and snails, are potentially important prey for other fish, waterfowl, and mammal species.

Characterization of the aquatic habitat provided by North Walnut Creek is of primary consideration with regards to aquatic risk. Attachment 1 provides a more detailed summary of the AEU ecological setting. Currently sustained flows exist, albeit minimal in nature, that support some aquatic species. Given the nature of ongoing accelerated actions, the location and amount of viable aquatic habitat that will be present after accelerated actions are complete is unclear because overland flow will be altered by the IA accelerated actions and removal of buildings and pavement.

2.0 ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IDENTIFICATION AND RISK CHARACTERIZATION

The methods and results of both the ECOPC and risk characterization process for sediment are described below. The process follows the CRA Methodology. Data for the NW AEU were evaluated to determine whether they were adequate for the CRA and for this evaluation. Data were determined adequate and the data adequacy evaluation is described in Volume 2 of the CRA (DOE 2005).

2.1 Ecological Contaminants of Potential Concern Identification Process and Results

Table A-1 summarizes the results of the sediment ECOPC identification process. The results of each successive step involved in the process are outlined within this table. The methods involved with each step and their outcome are described below.

The first step in the ECOPC identification process is a comparison of maximum detected concentrations (MDCs) of the ecological contaminants of interest (ECOIs) to the CRA Methodology-defined ecological screening levels (ESLs). ECOIs are all detected analytes in sediment samples from the NW AEU. If an MDC exceeds the ESL, the ECOI is retained for further analysis. Those ECOIs that have no ESLs available are retained for further assessment as ECOIs of uncertain toxicity in the uncertainty section of the CRA (Volume 15B) and will not be discussed further in this document.

The retained ECOIs were further evaluated based on their frequency of detection. For sediment, there were several ECOIs detected in less than 5 percent of the sediment samples. These ECOIs and corresponding figures include silver (Figure A-1), aldrin (Figure A-2), delta-BHC (Figure A-3), endosulfan I (Figure A-4), and Aroclor-1260 (Figure A-5).

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Table A-1
ECOPC Screening Step for Sediment in North Walnut Creek Aquatic Exposure Unit

ECOI	MDC	Sediment ESL	MDC > ESL?	Frequency of Detection	Detection Frequency > 5%?	MDC > BKG?	95th UTL > ESL?	ECOPC?
Inorganics (mg/kg)								
Aluminum	27400	15900	Yes	100.00%	Yes	Yes	Yes	**Yes**
Antimony	41.4	2	Yes	21.43%	Yes	Yes	Yes	**Yes**
Arsenic	10.2	9.79	Yes	97.10%	Yes	Yes	No	No
Barium	219	189	Yes	100.00%	Yes	Yes	Yes	**Yes**
Beryllium	2.1	N/A	N/A	48.44%	Yes	Yes	Yes	No
Boron	4.8	N/A	N/A	100.00%	Yes	Yes	Yes	No
Cadmium	4.4	0.99	Yes	19.12%	Yes	Yes	Yes	**Yes**
Calcium	140000	N/A	N/A	100.00%	Yes	Yes	Yes	No
Cesium	5.8	N/A	N/A	27.12%	Yes	No	NA	No
Chromium	66.5	43.4	Yes	95.31%	Yes	Yes	No	No
Chromium VI	0.008	43.4	No	28.57%	Yes	Yes	Yes	No
Cobalt	20.1	N/A	N/A	92.31%	Yes	Yes	Yes	No
Copper	77.6	31.6	Yes	96.88%	Yes	Yes	No	No
Fluoride	16.72	0.01	Yes	57.14%	Yes	Yes	Yes	**Yes**
Iron	37100	20000	Yes	100.00%	Yes	Yes	Yes	**Yes**
Lead	234	35.8	Yes	100.00%	Yes	Yes	Yes	**Yes**
Lithium	16.6	N/A	N/A	69.41%	Yes	No	NA	No
Magnesium	6000	N/A	N/A	100.00%	Yes	Yes	Yes	No
Manganese	1760	630	Yes	100.00%	Yes	Yes	Yes	**Yes**
Mercury	0.47	0.18	Yes	24.64%	Yes	No	NA	No
Molybdenum	2.7	N/A	N/A	8.70%	Yes	No	NA	No
Nickel	31.6	22.7	Yes	85.94%	Yes	Yes	Yes	**Yes**
Nitrate (as nitrogen)	4.53	N/A	N/A	100.00%	Yes	No	NA	No
Nitrate / Nitrite	52.9	N/A	N/A	38.10%	Yes	No	NA	No
Nitrite (as nitrogen)	5.61	N/A	N/A	6.67%	Yes	No	NA	No
Potassium	3860	N/A	N/A	91.30%	Yes	Yes	Yes	No
Selenium	2.4	0.95	Yes	22.22%	Yes	Yes	Yes	**Yes**
Silver	4.1	1	Yes	3.39%	No	No	NA	No
Sodium	2010	N/A	N/A	91.30%	Yes	Yes	Yes	No
Strontium	526	N/A	N/A	100.00%	Yes	Yes	Yes	No
Thallium	1.6	N/A	N/A	13.24%	Yes	Yes	Yes	No
Tin	12.9	N/A	N/A	5.80%	Yes	No	NA	No
Titanium	180	N/A	N/A	100.00%	Yes	Yes	Yes	No
Vanadium	62.7	N/A	N/A	100.00%	Yes	Yes	Yes	No
Zinc	704	121	Yes	100.00%	Yes	Yes	Yes	**Yes**
Organics (µg/kg)								
1,1,2,2-Tetrachloroethane	2	1900	No	1.33%	No	N/A	N/A	No
1,2-Dichloroethene	3	N/A	N/A	1.82%	No	N/A	N/A	No
2-Butanone	43	N/A	N/A	17.39%	Yes	N/A	N/A	No

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ECOI	MDC	Sediment ESL	MDC > ESL?	Frequency of Detection	Detection Frequency > 5%?	MDC > BKG?	95th UTL > ESL?	ECOPC?
2-Methylnaphthalene	2000	20.2	Yes	7.78%	Yes	Yes	Yes	**Yes**
2-Methylphenol	200	6970	No	1.23%	No	N/A	N/A	No
4,4'-DDT	4.9	4.16	Yes	5.06%	Yes	Yes	Yes	**Yes**
4-Isopropyltoluene	39	N/A	N/A	12.50%	Yes	N/A	N/A	No
4-Methyl-2-pentanone	6	N/A	N/A	1.43%	No	N/A	N/A	No
Acenaphthene	620	6.71	Yes	26.67%	Yes	Yes	Yes	**Yes**
Acetone	260	N/A	N/A	10.14%	Yes	N/A	N/A	No
Aldrin	54	8.25	Yes	1.45%	No	N/A	N/A	No
Anthracene	970	57.2	Yes	42.22%	Yes	N/A	N/A	**Yes**
Atrazine	120	16.81	Yes	100.00%	Yes	N/A	N/A	**Yes**
Benzene	3	260	No	1.33%	No	N/A	N/A	No
Benzo(a)anthracene	1400	108	Yes	56.41%	Yes	Yes	Yes	**Yes**
Benzo(a)pyrene	1300	150	Yes	52.56%	Yes	Yes	Yes	**Yes**
Benzo(b)fluoranthene	1500	N/A	N/A	50.62%	Yes	Yes	Yes	No
Benzo(g,h,i)perylene	270	13	Yes	16.00%	Yes	Yes	Yes	**Yes**
Benzo(k)fluoranthene	1100	240	Yes	34.57%	Yes	Yes	Yes	**Yes**
Benzoic Acid	510	N/A	N/A	14.04%	Yes	N/A	N/A	No
bis(2-ethylhexyl)phthalate	7800	24900	No	49.38%	Yes	N/A	N/A	No
Butylbenzylphthalate	120	11400	No	4.41%	No	N/A	N/A	No
Carbazole	300	25.2	Yes	47.62%	Yes	Yes	Yes	**Yes**
Chrysene	1500	166	Yes	70.00%	Yes	Yes	Yes	**Yes**
delta-BHC	13	2.37	Yes	1.43%	No	N/A	N/A	No
Dibenz(a,h)anthracene	200	33	Yes	5.80%	Yes	Yes	Yes	**Yes**
Dibenzofuran	300	325	No	6.17%	Yes	N/A	N/A	No
Diethylphthalate	25	108	No	1.25%	No	N/A	N/A	No
Di-n-butylphthalate	86	612	No	7.89%	Yes	N/A	N/A	No
Di-n-octylphthalate	130	N/A	N/A	5.08%	Yes	N/A	N/A	No
Endosulfan I	20	0.69	Yes	1.27%	No	N/A	N/A	No
Fluoranthene	3100	423	Yes	75.56%	Yes	Yes	Yes	**Yes**
Fluorene	650	77.4	Yes	18.89%	Yes	Yes	Yes	**Yes**
Indeno(1,2,3-cd)pyrene	510	17	Yes	32.10%	Yes	Yes	Yes	**Yes**
Methylene Chloride	7	N/A	N/A	5.41%	Yes	N/A	N/A	No
Naphthalene	310	176	Yes	10.59%	Yes	Yes	Yes	**Yes**
Aroclor-1254[a]	920	40	Yes	27.27%	Yes	Yes	Yes	**Yes**
PCB-1260[a]	180	40	Yes	1.02%	No	N/A	N/A	No
Pentachlorophenol	39	255	No	1.11%	No	N/A	N/A	No
Phenanthrene	3300	204	Yes	70.00%	Yes	Yes	Yes	**Yes**
Phenol	22	773	No	1.11%	No	N/A	N/A	No
Pyrene	3900	195	Yes	74.44%	Yes	Yes	Yes	**Yes**
Tetrachloroethene	2	3050	No	1.43%	No	N/A	N/A	No
Toluene	860	1660	No	29.33%	Yes	N/A	N/A	No
Trichloroethene	13	22800	No	4.29%	No	N/A	N/A	No
Radionuclides (pCi/g)								
Americium-241	13.23	5150	No	88.24%	Yes	Yes	No	No

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ECOI	MDC	Sediment ESL	MDC > ESL?	Frequency of Detection	Detection Frequency > 5%?	MDC > BKG?	95th UTL > ESL?	ECOPC?
Cesium-137	0.6853	3120	No	72.84%	Yes	Yes	No	No
Gross Alpha	70.68	N/A	N/A	100.00%	Yes	No	No	No
Gross Beta	39.25	N/A	N/A	100.00%	Yes	No	No	No
Plutonium-239/240	36.2	5860	No	94.85%	Yes	Yes	No	No
Radium-226	3.08	101	No	100.00%	Yes	No	No	No
Radium-228	2.4	87.8	No	100.00%	Yes	No	No	No
Strontium-89/90	0.321	582	No	100.00%	Yes	No	No	No
Uranium-233/234	3.669	N/A	N/A	100.00%	Yes	No	No	No
Uranium-235	0.2013	3730	No	77.17%	Yes	No	No	No
Uranium-238	5.9482	2490	No	100.00%	Yes	No	No	No
Strontium-89/90	0.5791	582	No	100.00%	Yes	No	No	No
Uranium-233/234	3.669	N/A	N/A	100.00%	Yes	No	No	No
Uranium-235	0.2013	3730	No	100.00%	Yes	No	No	No
Uranium-238	5.9482	2490	No	100.00%	Yes	No	No	No

[a]PCBs will be evaluated as total PCB.

Based on a review of the spatial extent of chemicals with detection frequencies less than 5 percent (Figures A-1 through A-5), most of these ECOIs are detected outside of the stream channel, and within the IA portion that overlaps and is part of the NW AEU. They are not typically associated with the ponds, the exception being aldrin and delta-BHC, which were detected at one location at the mouth of Pond A-2. All of these chemicals typically occur in only one location, indicating a very limited spatial extent. In general, in order for a chemical to have an impact to a population, there needs to be a spatial distribution of that chemical throughout a habitat area at concentrations of potential concern. This does not appear to be the case for these chemicals. These ECOIs are eliminated from further consideration in North Walnut Creek because they are unlikely to present risks to the population of receptors that may inhabit North Walnut Creek.

The distributions of the inorganic ECOIs that had MDCs greater than ESLs were also evaluated relative to the distribution of ECOI concentrations in the site-specific background sets. The background comparison step follows the methodology agreed to through the consultative process and documented in Volume 2 of the CRA.

Of the remaining inorganic ECOIs in sediment, only mercury had a data distribution that was not significantly greater than the concentration in the sitewide background sediment data set. Mercury was eliminated from further consideration because it is unlikely to present risks to the populations of receptors that inhabit North Walnut Creek. The risk created by mercury would not exceed the risk already associated with background conditions.

The final step in the ECOPC identification process involved calculating upper-bound exposure point concentrations (EPCs) for all remaining ECOIs, which was then compared to the ESLs. The EPC is calculated as the 95th upper tolerance limit (UTL) (95th upper confidence limit [UCL] of the 90th percentile). Where sufficient data were unavailable to

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calculate statistical parameters, the MDC was used as the default EPC. The EPC was then compared to the ESLs from the CRA Methodology. Analytes with EPCs that exceed their respective ESLs are identified as final ECOPCs and are discussed further in this assessment.

The MDCs for arsenic, chromium, and copper in sediment were greater than their respective ESLs. However, the UTL EPCs for these ECOIs were less than the ESLs. Therefore, in accordance with the CRA Methodology, these chemicals were removed from further evaluation. To ensure that these ECOIs were not a risk concern in sediment for an isolated aquatic population within the ponds of North Walnut Creek, the spatial distributions of these ECOIs were evaluated by plotting the measured concentrations compared to the ESL and a toxicity threshold (typically representative of a lowest observed adverse effect level [LOAEL] or other applicable value). Attachment 2 provides a summary description of the toxicity thresholds and their endpoints. The CRA Methodology ESLs represent a conservative benchmark for screening comparisons, while the toxicity threshold represents a less conservative benchmark correlation to a mid-range, or lowest-effect level concentration. Comparison of an EPC to both the ESL and toxicity threshold helps put into perspective the risk potential attributable to a given ECOPC.

The distributions of these chemicals are shown on Figures A-6, A-7, and A-8, and typically occur at concentrations less than the ESL. Their distribution is not concentrated in pond areas, nor are they widespread throughout the drainage at concentrations of concern. Measured concentrations of arsenic and chromium occur below the ESLs in all instances, except for one location (Figures A-6 and A-7, respectively). Measured concentrations of copper occur below the ESL in all instances except for two locations, one of which occurs within the portion of the IA that overlaps the NW AEU (Figure A-8). It appears that the spatial extent of these chemicals is not of concern to aquatic populations within the drainage, or within pond areas in particular.

Additional data have recently been gathered (since the December 15, 2004 data set used in this evaluation) for metals, radionuclides, dioxins, and volatile organic compounds (VOCs) in depositional areas of the North Walnut Creek area. One sample from the North Walnut Creek drainage area and two from the ponds were collected and analyzed. The evaluation of these results is provided in Attachment 3.

2.2 Risk Characterization

The ECOPC identification process defined the steps necessary to identify those chemicals that could not reliably be removed from further consideration in the ecological screening process. The list of ECOPCs represents those chemicals in the NW AEU that require risk characterization. The sediment ECOPCs requiring further evaluation included:

- Aluminum;
- Antimony;
- Barium;
- Cadmium;
- Fluoride;

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- Iron;
- Lead;
- Manganese;
- Nickel;
- Selenium;
- Zinc;
- 2-Methylnaphthalene;
- 4,4-DDT;
- Acenaphthene;
- Anthracene;
- Atrazine;
- Benzo(a)anthracene;
- Benzo(a)pyrene;
- Benzo(g,h,i)perylene;
- Benzo(k)Fluoranthene;
- Carbazole;
- Chrysene;
- Dibenz(a,h)anthracene;
- Fluoranthene;
- Fluorene;
- Indeno(1,2,3-cd)pyrene;
- Naphthalene;
- Aroclor-1254;
- Phenanthrene; and
- Pyrene.

For the purposes of this risk characterization, all available sediment data for the NW AEU were used. The resulting UTL ECOPC concentrations were developed and used as the EPCs. If the UTL result was greater than the MDC, the MDC was the assumed EPC for the risk estimation.

Several lines of evidence were compiled to complete the risk characterization of NW AEU. The following strategies were applied:

- Using the hazard quotient (HQ) method, both the UTL (or MDC, whichever was less) and 95 UCL of the mean EPC were compared to the original ESL and the appropriate chemical toxicity threshold (Table A-2). The HQs were developed using the following standard equation: EPC/ESL or Toxicity Threshold = HQ. Only those chemicals that yielded HQs greater than 1 using the ESL for both the UTL and 95 UCL of the mean EPC were retained for further analysis (Step 2 below).

- For the purposes of the ecological screening, only those ECOPCs requiring further risk characterization were mapped (Figures A-9 through A-25). Each sampling location with a detected ECOPC is shown. The result is compared to

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appropriate ESLs and defined as having low (less than the CRA Methodology-defined ESL, no observed adverse effect level [NOAEL], or equivalent), low-to-moderate (greater than the CRA Methodology ESL, but less than the toxicity threshold), or moderate (greater than the toxicity threshold which is equivalent to a LOAEL or similar value) risk potential.

2.2.1 Results of the Hazard Quotient Analysis

Results of the HQ analysis for sediment indicated the following:

- The risk potential attributable to aluminum, barium, cadmium, iron, lead, manganese, nickel, selenium, 2-methylnaphthalene, 4,4-DDT, benzo(k)fluoranthene, and fluoranthene was low because HQ values were at or below 1.

- Sediment ECOPCs that require further analysis include antimony, fluoride, zinc, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, carbazole, chrysene, dibenz(a,h)anthracene, fluorene, indeno(1,2,3-cd)pyrene, naphthalene, Aroclor-1254, phenanthrene, and pyrene.

2.2.2 Results of the Spatial Extent Analysis

The spatial extent of the sediment ECOPCs with elevated HQs are provided on Figures A-9 through A-25. The spatial extent of these chemicals indicates similar trends as follows:

- For acenaphthene (Figure A-12), anthracene (Figure A-13), benzo(g,h,i)perylene (Figure A-16), indeno(1,2,3-cd)pyrene (Figure A-21), naphthalene (Figure A-22), Aroclor-1254 (Figure A-23), phenanthrene (Figure A-24), and pyrene (Figure A-25), the observed concentrations generally were less than ESLs indicating a low risk potential. There is no depositional trend for these chemicals that would create isolated areas, such as a pond, to be affected. The risk to a population within the pond areas of North Walnut Creek for these ECOPCs is low.

- For antimony (Figure A-9) fluoride (Figure A-10), zinc (Figure A-11), benzo(a)anthracene (Figure A-14), benzo(a)pyrene (Figure A-15), carbazole (Figure A-17), chrysene (Figure A-18), dibenz(a.h)anthracene (Figure A-19), and fluorene (Figure A-20), the measured concentrations within the drainage were predominantly less than ESLs indicating a low risk potential. The only locations with measured values greater than the ESLs occurred where the IA overlapped with the NW AEU. Therefore, the risk to aquatic populations within the pond areas of the drainage would be low. In the interest of being conservative, however, polycyclic aromatic hydrocarbon (PAH) constituents (acenaphthene, anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, carbazole, chrysene, dibenz[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, naphthalene, phenanthrene, and pyrene) were further evaluated because these chemicals in combination (co-located constituents within a given pond) may be of concern.

Table A-2
Hazard Quotients for Sediment ECOPCs in the North Walnut Creek Aquatic Exposure Unit

ECOPC	ESL	Toxicity Threshold	95 UTL EPC HQs			95UCL EPC HQs			Further Characterization Required?
			EPC	ESL-HQ	Tox.Threshold-HQ	EPC	ESL-HQ	Tox.Threshold-HQ	
Inorganics (mg/kg)									
Aluminum	15900	58000	19900	1.25	0.3	11100	0.69	0.2	No
Antimony	2	3.2	29.6	**15**	9	16.4	**8**	5	**Yes**
Barium	189	287	193	1	1	124	1	0.5	No
Cadmium	0.99	4.98	3.1	3	1	1.27	1.28	0.3	No
Fluoride	0.01	7	16.72	**1672**	2	4.69	**469**	1	**Yes**
Iron	20000	280000	22900	1	0.1	1700	0.1	0.01	No
Lead	35.8	128	47.5	1	0.4	40.5	1	0.3	No
Manganese	630	1700	1000	2	1	532	1	0.3	No
Nickel	22.7	48.6	25.6	1	1.5	15.7	1	0.3	No
Selenium	0.95	5	1.8	2	0.4	0.828	1	0.2	No
Zinc	121	459	401	**3**	1	204	**2**	0.4	**Yes**
Organics (µg/kg)									
2-Methylnaphthalene	20.2	201	495	**25**	2	18	1	0.1	No
4,4-DDT	4.16	62.9	4.9	1	0.1	18	4	0.3	No
Acenaphthene	6.71	1300	405	**60**	0.3	283	**42**	0.2	**Yes**
Anthracene	57.2	845	405	**7**	0.5	289	**5**	0.3	**Yes**
Benzo(a)anthracene	108	1050	580	**5**	1	358	**3**	0.3	**Yes**
Benzo(a)pyrene	150	1450	570	**4**	0.4	362	**2**	0.3	**Yes**
Benzo(g,h,i)perylene	13	280	270	**21**	1	319	**25**	1	**Yes**
Benzo(k)fluoranthene	240	750	495	2	1	351	1	0.5	No
Carbazole	25.2	1600	300	**12**	0.2	252	**10**	0.2	**Yes**
Chrysene	166	1290	730	**4**	1	398	**2**	0.3	**Yes**
Dibenz(a,h)anthracene	33	230	200	**6**	1	269	**8**	1	**Yes**
Fluoranthene	423	2230	1500	4	1	559	1	0.3	No
Fluorene	77.4	536	470	**6**	1	327	**4**	1	**Yes**

ECOPC	ESL	Toxicity Threshold	95 UTL EPC HQs			95UCL EPC HQs			Further Characterization Required?
			EPC	ESL-HQ	Tox.Threshold-HQ	EPC	ESL-HQ	Tox.Threshold-HQ	
Indeno(1,2,3-cd)pyrene	17	250	490	**29**	2	318	**19**	1	**Yes**
Napthalene	176	561	310	**2**	1	276	**2**	0.5	**Yes**
Aroclor-1254	60	300	350	**6**	1	227	**4**	1	**Yes**
Phenanthrene	204	1170	1300	**6**	1	623	**3**	0.5	**Yes**
Pyrene	195	1520	1500	**8**	1	527	**3**	0.4	**Yes**

Bold analytes require further risk characterization.

- Aroclor-1254 was further evaluated. Figure A-26 depicts the spatial extent of Aroclor-1254, which demonstrates that the majority of observations occur at levels below the ESLs indicating a low risk potential. Figure A-26 shows the measured values in surface sediment greater than the ESL and toxicity thresholds. As shown on this figure, few measured values occur above the toxicity threshold indicating a moderate risk potential. Pond-specific polychlorinated biphenyl (PCB) results are provided in Figures A-27 and A-28 for Ponds A-1 and A-2, respectively, which contained the majority of observed PCB levels.

2.2.3 Additional Analysis of ECOPCs

Certain chemicals were evaluated further to better characterize the potential risk to aquatic populations in ponds. Those chemicals requiring further analysis included Aroclor-1254 and PAHs in sediment. Several approaches to understand the risk potential attributable to these chemicals were taken, and are described below.

Aroclor-1254

As an additional risk characterization approach, the maximum total PCB concentration was determined for the entire AEU, as well as for each pond. For the NW AEU, the only PCB mixture detected was Aroclor-1254; therefore, the total PCBs equals Aroclor-1254.

The results yield a maximum total concentration for the NW AEU of 920 micrograms per kilogram (µg/kg). When compared to the total PCB toxicity thresholds described by MacDonald et al., the NW AEU total value is less than the extreme effect concentration (EEC) of 1,700 µg/kg and greater than the mid-range effect concentration (MEC) of 400 µg/kg. The EEC is defined as the value above which adverse effects can be expected. The MEC is the value above which adverse effects are likely (frequently observed with an incidence of toxicity being more than 50 percent).

Pond-specific surface sediment PCB concentrations are shown on Figures A-27 and A-28. As shown on these figures, Ponds A-1 and A-2 have measured values greater than the 40 µg/kg ESL value for total PCBs and the 60 µg/kg ESL for Aroclor-1254. Pond A-1 values are less than the total PCB MEC of 400 µg/kg, as well as the Aroclor-1254 specific toxicity threshold of 300 µg/kg. The 300 µg/kg value represents a toxic effect threshold for Aroclor-1254, above which adverse effects are expected. Pond A-2 has one value greater than the 400 µg/kg MEC for total PCBs (and the Aroclor-1254 specific toxicity threshold of 300 µg/kg).

The maximum total PCB concentration was 160 µg/kg for Pond A-1, and 590 µg/kg for Pond A-2. The value for Pond A-1 falls below the MEC of 400 µg/kg for total PCBs and the Aroclor-1254 specific toxicity threshold of 300 µg/kg.

Evaluation of the distinct PCB mixtures detected indicates the following:

- Aroclor-1260 was detected in one sample at a concentration of 160 µg/kg. This falls below the toxic effect threshold of 200 µg/kg for Aroclor-1260 (MacDonald et al. 2000). Aroclor-1260 was removed from the ECOPC process because of its low frequency of detection. It is being included in this step as a conservative method to incorporate all detected PCB mixtures in the total PCB value.

- Aroclor-1254 was detected in 30 of 110 samples, with a range of detected concentrations from 7.3 to 920 µg/kg and a mean concentration of 173 µg/kg. The mean is less than the toxic effect threshold for Aroclor-1254 (300 µg/kg) (MacDonald et al. 2000).

Additional lines of evidence gathered from previous studies, such as the in-situ bioassay results add to the conclusion that Aroclor-1254 does not appear to pose a risk to aquatic populations within the ponds (DOE 1995). Results of the in-situ bioassays revealed no effect to test organisms exposed to Pond A-4 and Pond A-5 sediment. Organism survival in test sediment for Pond A-4 was 95 percent versus a control of 74 percent, in Pond A-5, survival was 89 percent versus a control of 74 percent. In addition, tissue studies at these ponds have not demonstrated any bioaccumulation or bioconcentration of PCBs to levels of concern (DOE 1994). Results of a PCB spatial extent study demonstrated that concentrations in both sediment and fish tissue decreased downgradient. In addition, the observed concentrations were deemed nontoxic to higher trophic organisms such as birds and wildlife species. These combined lines of evidence indicate PCBs do not pose a risk to aquatic populations within the ponds.

PAHs

As shown on the sediment ECOPC maps, certain PAHs occur in co-located areas within ponds (specifically Ponds A-1 and A-2) (Figures A-29 and A-30). The measured concentrations are variable, with inconsistent trends regarding measured concentrations. (There are no consistently high PAH concentrations in co-located areas.) When spatially reviewed (Figure A-29), the PAHs occur within the portion of the IA that overlaps the NW AEU. This indicates the drainage itself contains few of the measured values. Further spatial review of the ponds (Figure A-30) shows some overlap of certain PAHs; however, these measured values occur within the channel portion of the drainage, and not within the pond areas. In addition, the spatial extent of PAHs is very minimal within the drainage area as a whole.

While the spatial extent evaluation does not indicate a concern, further evaluation was undertaken because PAHs in combination can behave synergistically and present a potential problem to aquatic populations within pond areas. Further evaluation involved gathering existing information from the pond-specific evaluations from the Operable Unit (OU) 5/OU 6 Watershed Ecological Risk Assessment (ERA) Report (DOE 1994). These studies were reviewed to determine whether the PAHs correlated to other lines of evidence indicating potential ecological risk.

During the OU 5/OU 6 investigations, sediment bioassay studies were conducted using *Hyallela azteca*, tissue analysis, and pond-specific chemical risk assessment methods. Results are summarized as follows:

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- For Pond A-1, the sediment bioassay results yielded test survival percentages that were greater than the control (95 percent in the test media versus 74 percent in control) for *Hyallela Azteca.*

- For Pond A-2, the sediment bioassay results yielded test survival percentages that were greater than the control (89 percent in the test media vs. 74 percent in control) for *Hyallela azteca.*

The results of the bioassays provide a direct measure of the toxicity potential attributable to the sediments. The results of the bioassays put in perspective the conservative results indicated from the initial HQ analysis. In order to further evaluate the PAH risk to bottom-dwelling organisms such as the *Hyallela* species, literature-derived toxicity thresholds for *Hyallela* were obtained for the detected PAH ECOPCs. Table A-3 presents a summary of the 95th UTL HQs for these toxicity values. Results indicate HQs range from possible effect levels (greater than 10) to minimal effect levels (less than 1). While the HQs range from 0 to 68, the toxicity potential, as demonstrated by the bioassays, is low.

Given the combined lines of evidence gathered from the previous studies (bioassays) and the low HQs, it does not appear that PAHs present a risk concern to aquatic populations within the pond areas.

3.0 SUMMARY AND CONCLUSIONS

Multiple lines of evidence were gathered to evaluate the aquatic risk conditions within the NW AEU pond areas. The drainage-wide approach, as described within the CRA Methodology was followed. After ECOPCs were identified, potential concerns associated with the ponds were evaluated. An evaluation of the risk potential was conducted using a standard HQ approach, along with an evaluation of the spatial extent of certain ECOPCs requiring further analysis. Certain chemicals were assessed further by evaluating other lines of evidence such as those gathered from previous studies (OU 5/OU 6 Watershed ERA).

Of the ECOPCs carried through the process, all were characterized as having low risk potential. The spatial distribution evaluation indicates similar trends among the ECOPCs evaluated. There were a few locations where observed concentrations exceeded ESL values. Detailed analysis of certain chemicals indicates the magnitude of the concentrations of ECOPCs is not substantial compared to the ESLs and toxicity thresholds. Review of pond-specific conditions identified Aroclor-1254 as a potential chemical risk issue. PAHs were also evaluated further due to their potential co-location within a given pond. However, further analysis using other lines of evidence (in-situ bioassay and tissue analysis results, and further review of literature toxicity information) supports the conclusion that Aroclor-1254 and PAHs are not of concern.

The aquatic conditions within North Walnut Creek indicate this drainage is controlled by ephemeral flow conditions. The aquatic life within the system is highly susceptible to changes in flow and, in turn, is represented as an opportunistic assemblage of aquatic

Table A-3
Revised Hazard Quotients for Sediment ECOPCs using *Hyallela Azteca* Toxicity Thresholds in the North Walnut Creek Aquatic Exposure Unit

ECOPC[a]	Unit	*Hyallela Azteca* Toxicity Threshold						95 UTL EPC HQs						
		ERL	ERM	PAETA	AETA	TELHA2B	PELHA2B	EPC	ERL-HQ	ERM-HQ	PAETA-HQ	AETA-HQ	TELHA2B-HQ	PELHA2B-HQ
Antimony	mg/kg	*	*	2100	2800	*	*	29.6			1	0.01		
Fluoride	mg/kg	*	*	*	*	*	*	16.72						
2-Methylnaphthalene	ug/kg	*	*	*	*	*	*	495						
Acenaphthene	ug/kg	16	500	77000	100000	*	*	405	**25**	1	0.01	0.00		
Anthracene	ug/kg	10	140	28000	41000	10	170	405	***41***	3	0.01	0.01	***41***	2
Benzo(a)anthracene	ug/kg	*	*	*	*	16	280	580					**36**	**36**
Benzo(a)pyrene	ug/kg	84	*	9700	25000	32	320	570	7		0.06	0.02	**18**	2
Benzo(g,h,i)perylene	ug/kg	13	280	4900	21000	*	*	270	**21**	1	0.06	0.01		
Carbazole	ug/kg	*	*	1600	1800	*	*	300			0.2	0.2		
Chrysene	ug/kg	30	500	19000	39000	27	410	730	**24**	1	0.04	0.02	**27**	2
Dibenz(ah)anthracene	ug/kg	10	*	2200	3500	10	*	200	***20***		0.1	0.1	***20***	
Fluorene	ug/kg	*	*	*	*	10	150	470					**47**	3
Indeno(123-cd)pyrene	ug/kg	30	250	4100	15000	*	*	490	**16**	2	0.1	0.03		
Napthalene	ug/kg	13	98	47000	140000	15	140	310	**24**	3	0.01	0.00	**21**	2
Aroclor-1254	ug/kg	*	*	240	350	32	240	350			1	1	***11***	1
Phenanthrene	ug/kg	27	350	110000	210000	19	410	1300	***48***	4	0.01	0.01	**68**	3
Pyrene	ug/kg	40	350	46000	850000	44	490	1500	***38***	4	0.03	0.00	**34**	3

[a] Bold analytesrequire further risk characterization.
* Toxicity value not available in the references reviewed.
PAETA - AETA - Probable effects threshold for *Hyallela*; dry weight. (Source: Cubbage et al. 1997)
ERL – ERM - Effects range low and effects range median (*Hyallela* and *Chironomus*). (Source: Ingersoll et al. 1996)
TELHA2B and PELHA2B - Threshold effect level and probable effect level for *Hyallela azteca*. (Source: EPA 1996)

species. There have been no studies to indicate water quality is a controlling factor to the ecology. Instead, it is well documented that flow conditions are the controlling factor that limit the amount of available habitat year-round.

In summary, the lines of evidence support the conclusion that there is a low risk potential to populations of aquatic life within North Walnut Creek ponds as related to the ECOPCs. The overlying risk driver to these organisms is the habitat condition itself.

Sources of uncertainty associated with this evaluation exist. For instance, it was assumed that all of North Walnut Creek is viable aquatic habitat and that all areas sampled are equally important to the support of populations. This is a very conservative assumption because areas within North Walnut Creek are limited due to intermittent flows. In the interest of being conservative, however, it was also assumed those ECOPCs in areas that are not suitable habitat (which were sampled because of the presence of surface water and/or sediment, and had a possible connection to the drainage hydrology as a whole) could contribute to possible future exposure conditions to aquatic receptors that reside downgradient of this potential source. This assumption likely overestimates the exposure of these receptors because the hydrologic connectivity is unknown or unlikely. A discussion of historic study findings that evaluate the aquatic condition within North Walnut Creek is provided in Attachment 1.

Another uncertainty is associated with the use and selection of the toxicity thresholds. Toxicity thresholds for sediment reflect effects conditions typically correlated to lowest observed effects or similar. However, literature toxicity information can be limited for certain chemicals, yielding thresholds with varying endpoints. If a measured ECOPC concentration occurs above these values, it is unknown whether the magnitude of effect is attributable to the exposure. A discussion of the endpoints associated with these toxicity thresholds is provided in Attachment 2.

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4.0 REFERENCES

DOE, 1995. Final Phase 1, RFI/RI Report, Woman Creek Priority Drainage, Operable Unit 5, Appendix N. Ecological Risk Assessment for Walnut Creek and Woman Creek Watersheds at the Rocky Flats Environmental Technology Site, Golden, Colorado, September.

DOE, 2003, Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, Golden, Colorado, 2001-2002.

DOE, 2004a, Comprehensive Risk Assessment Work Plan and Methodology, Rocky Flats Environmental Technology Site, Golden, Colorado, September.

DOE, 2004b, Industrial Area and Buffer Zone Sampling and Analysis Plan, Modification 1, Rocky Flats Environmental Technology Site, Golden, Colorado, May.

DOE 2005, Comprehensive Risk Assessment, Rocky Flats Environmental Technology Site, Golden, Colorado (in prep).

Cubbage, J., D. Batts, and S. Breidenbach, 1997, Creation and Analysis of Freshwater Sediment Quality Values in Washington State, Publication No. 97-323a, Washington State Department of Ecology, Olympia, Washington.

EPA, 1996, Ecotox Thresholds, ECO Update, Vol. 3, No. 2.. Publ. 9345.0-12FS1, EPA 540/F-95/038.

Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and T.G. Fos, 1996, Calculation and evaluation of sediment effect concentrations for the amphipod Hyallela aztca and the midge *Chironomus riparius*. Journal of Great Lakes Research, 22(3): 602-623.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000, Development and evaluation of consensus-based sediment quality guidelines for fresh water ecosystems, Archives of Environmental Contamination, Toxicology, 39. 20-31.

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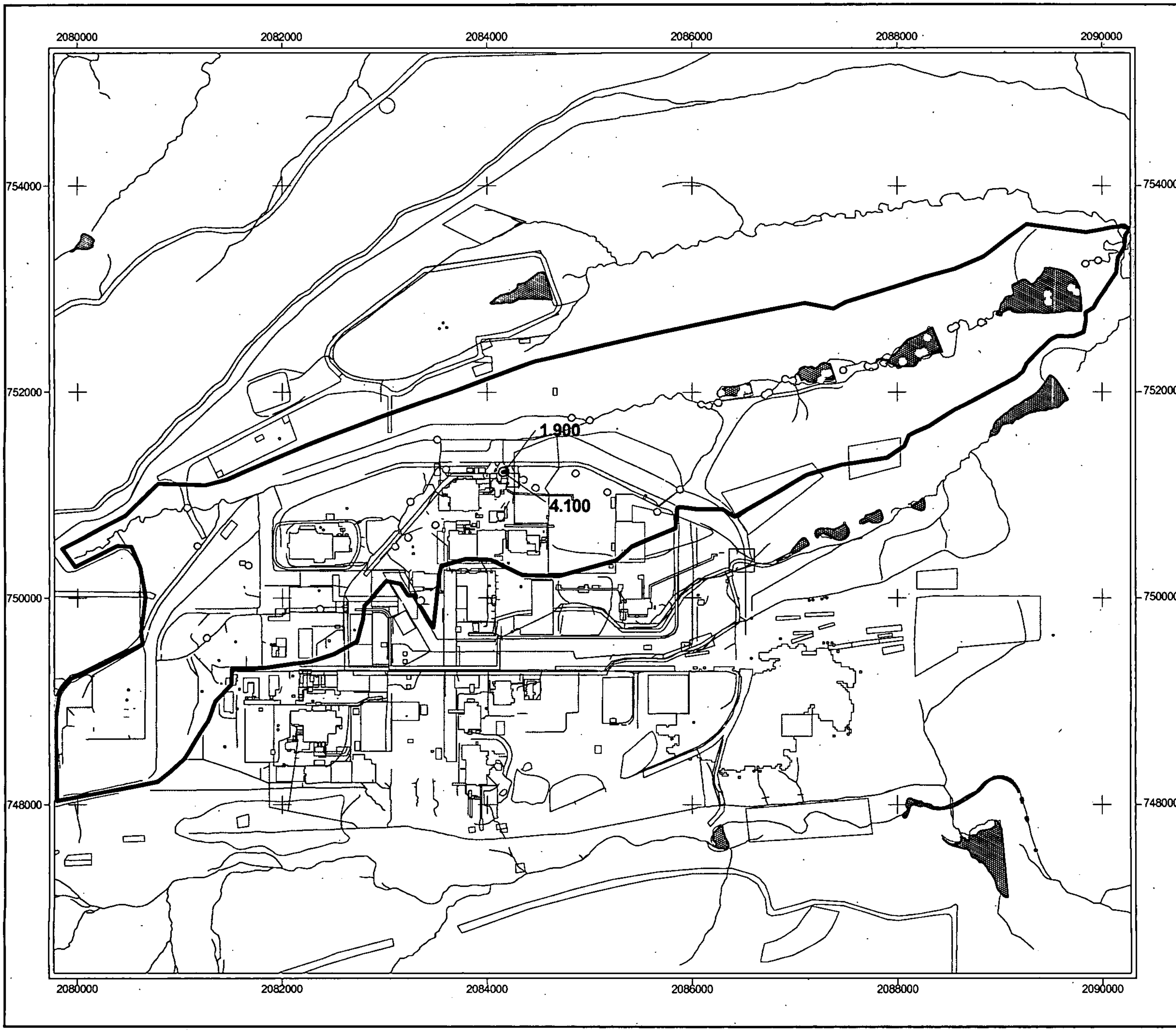
Figure A-1
North Walnut Creek AEU
Sediment Results
for Silver



KEY

1.0 Sample concentration (mg/kg)

Sampling location

O Detect

o Nondetect

Stream

Lake

North Walnut Creek AEU

IHSS/PAC/UBC

ESL = 1.0 mg/kg

DRAFT

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Scale 1:17,000

State Plane Coordinate Projection

Colorado Central Zone

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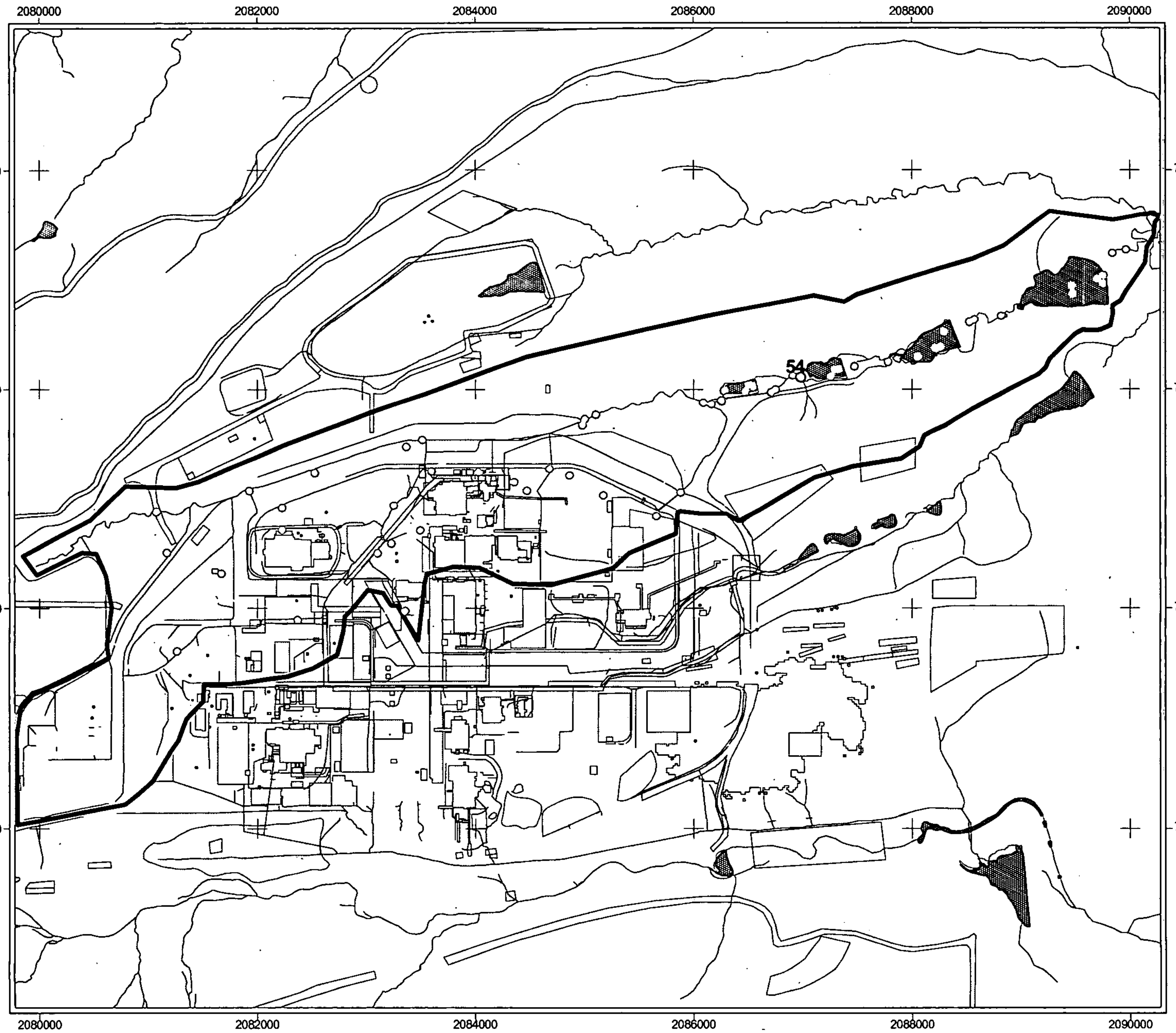

Figure A-2
North Walnut Creek AEU
Sediment Results
for Aldrin

KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Detect
- Nondetect
- Stream
- Lake
- North Walnut Creek AEU
- IHSS/PAC/UBC

ESL = 8.25x10(-3) mg/kg

DRAFT

Data Set: 12/15/04

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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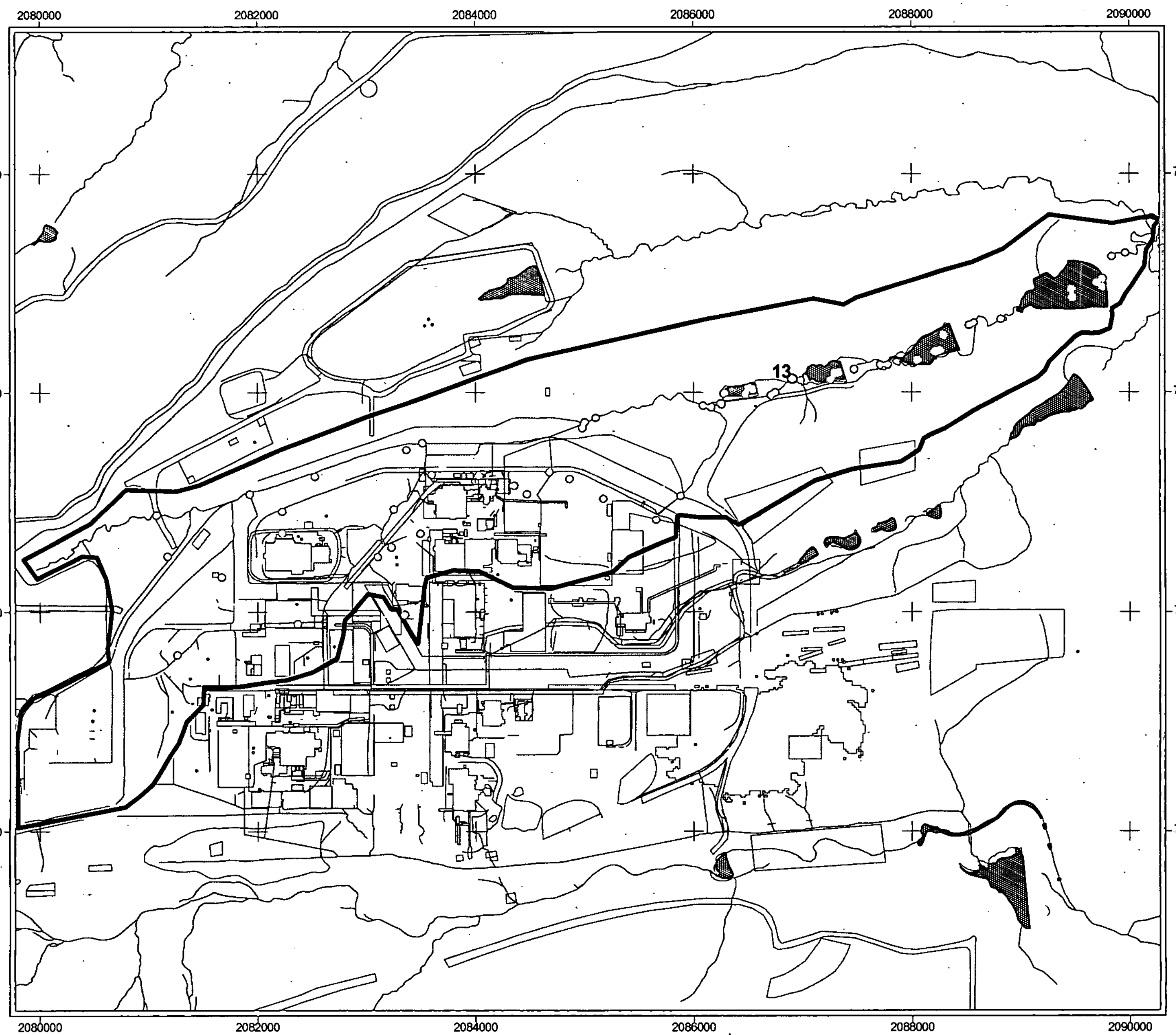

Figure A-3
North Walnut Creek AEU
Sediment Results
for Delta-BHC

KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Detect
- Nondetect
- Stream
- Lake
- North Walnut Creek AEU
- IHSS/PAC/UBC

ESL = 2.37 ug/kg

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Data Set: 12/15/04

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Datum: NAD 27

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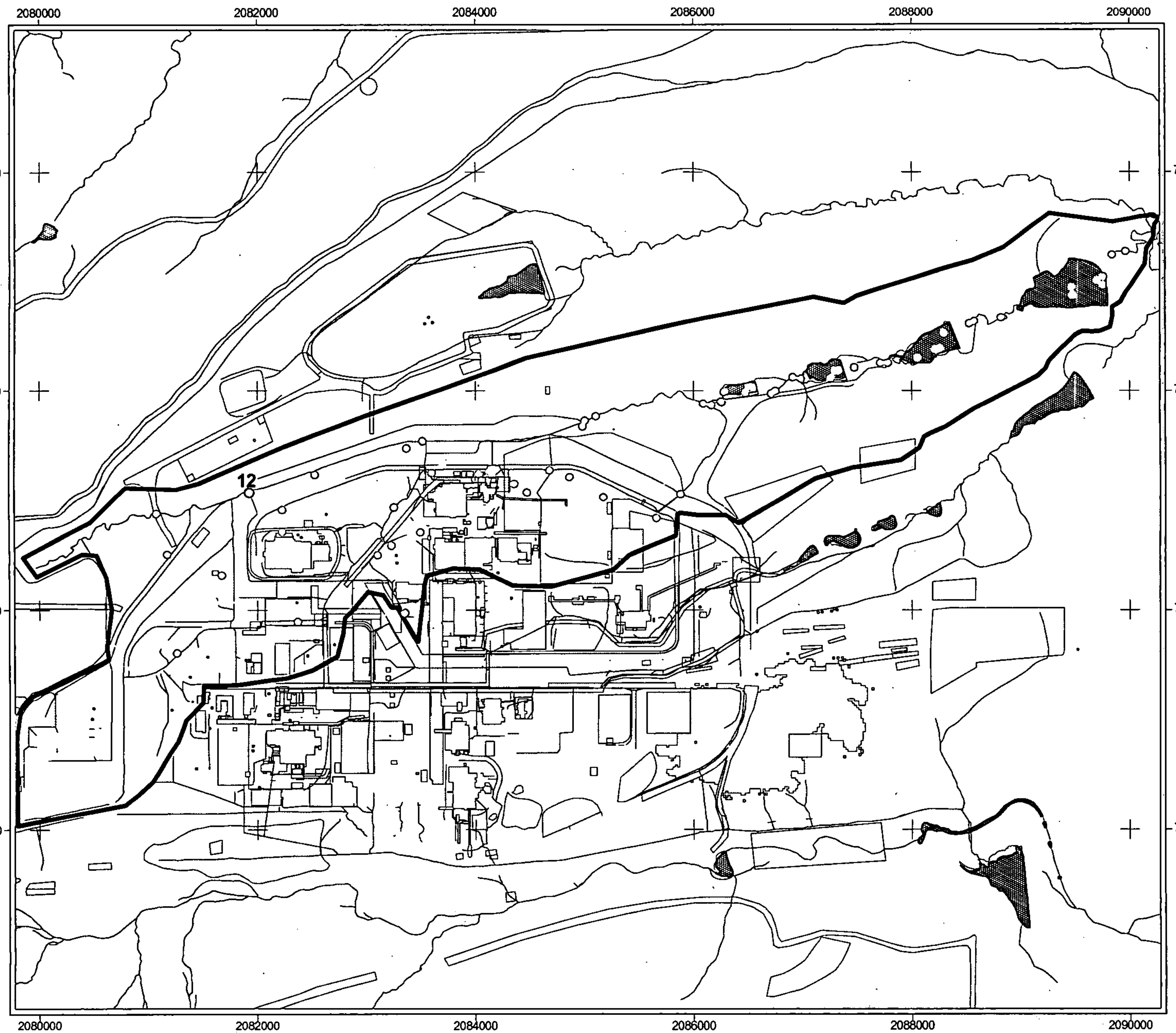

Figure A-4
North Walnut Creek AEU
Sediment Results
for Endosulfan I

KEY

1.0 Sample concentration (ug/kg)
Sampling location
Detect
Nondetect
Stream
Lake
North Walnut Creek AEU
IHSS/PAC/UBC

ESL = 0.69 ug/kg

DRAFT

Data Set: 12/15/04

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State Plane Coordinate Projection
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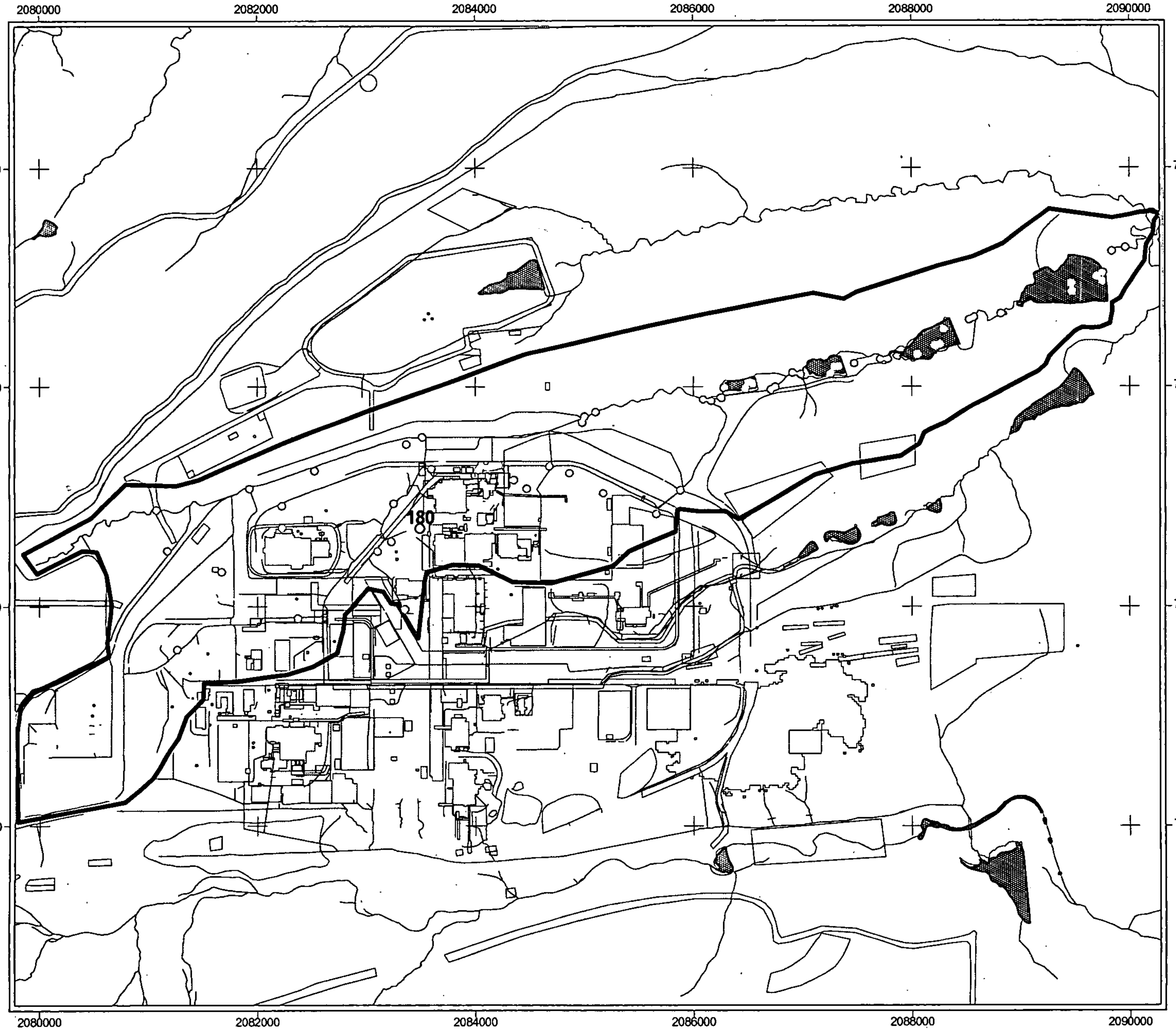

Figure A-5
North Walnut Creek AEU
Sediment Results
for PCB-1260

KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Detect
- Nondetect
- Stream
- Lake
- North Walnut Creek AEU
- IHSS/PAC/UBC

ESL = 40 ug/kg

DRAFT

Data Set: 12/15/04

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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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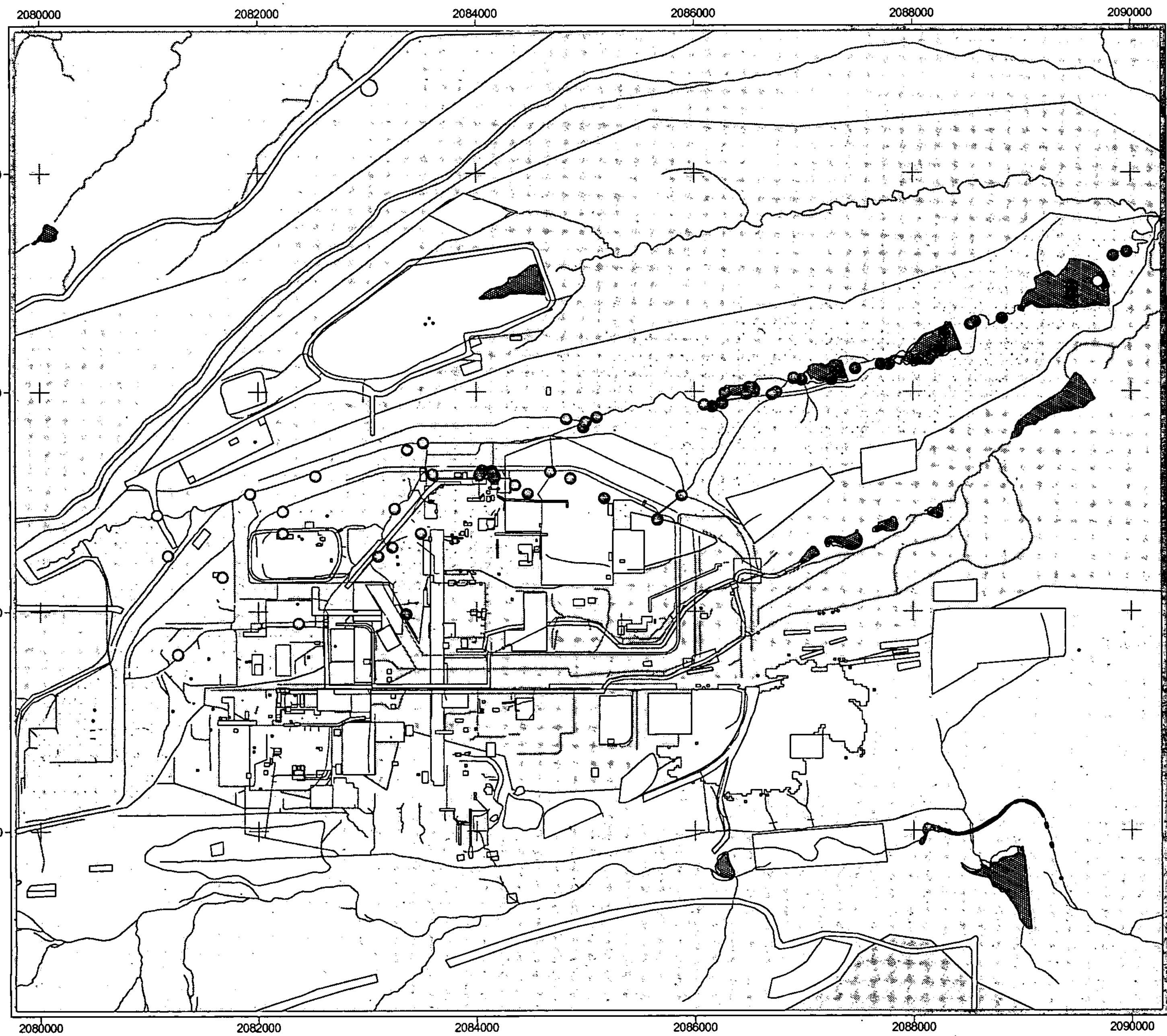

Figure A-6
North Walnut Creek AEU
Sediment Sampling Locations for Arsenic

KEY

Sampling location

- Moderate potential (>toxicity threshold = 33 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>9.8 and <33 mg/kg)
- Low potential (<ESL = 9.8 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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500 0 500 1000 1500 Feet

Scale 1: 17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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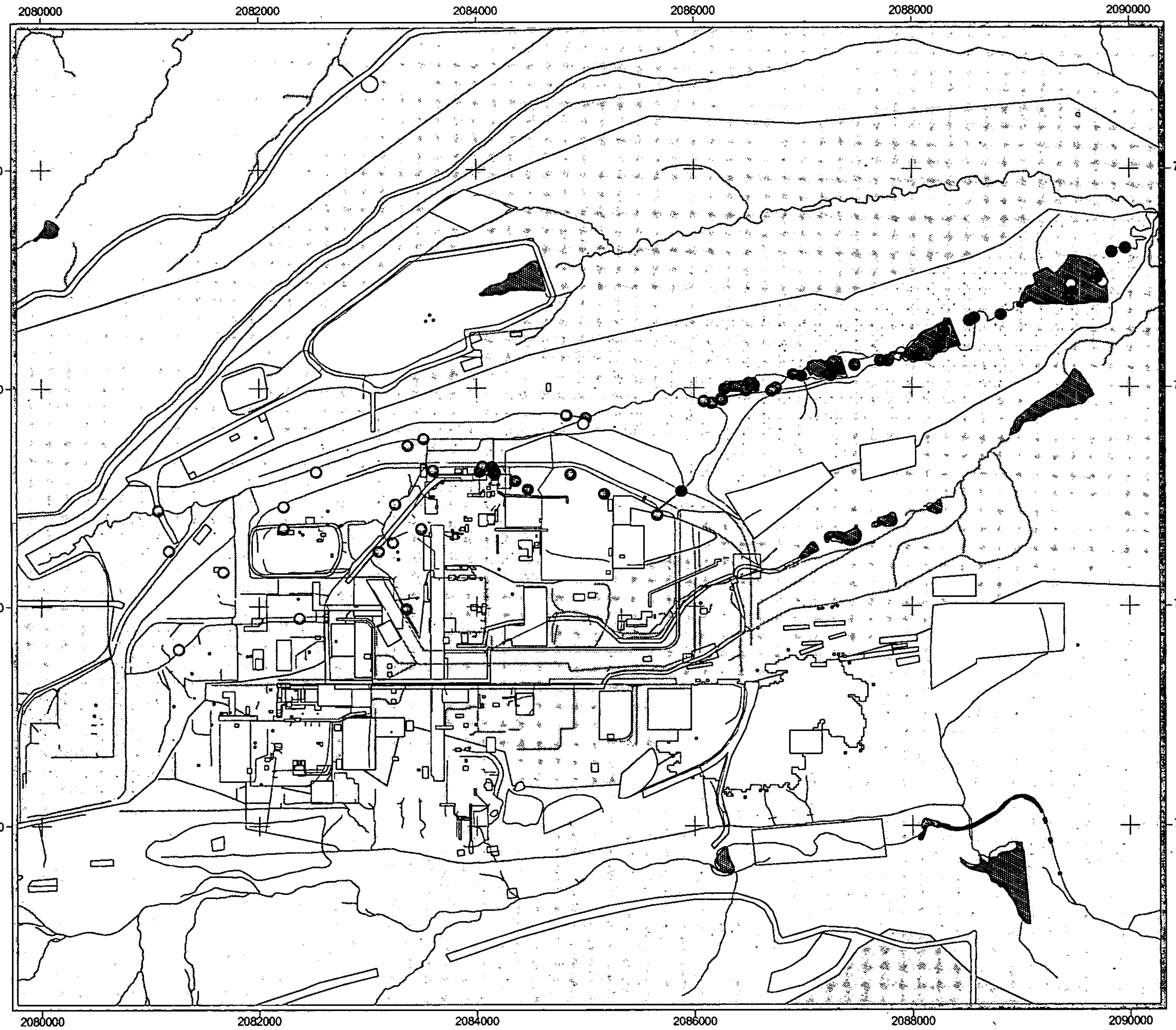

Figure A-7
North Walnut Creek AEU
Sediment Sampling Locations for
Chromium

KEY

Sampling location

- Moderate potential (>toxicity threshold = 111 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>43.4 and <111 mg/kg)
- Low potential (<ESL = 43.4 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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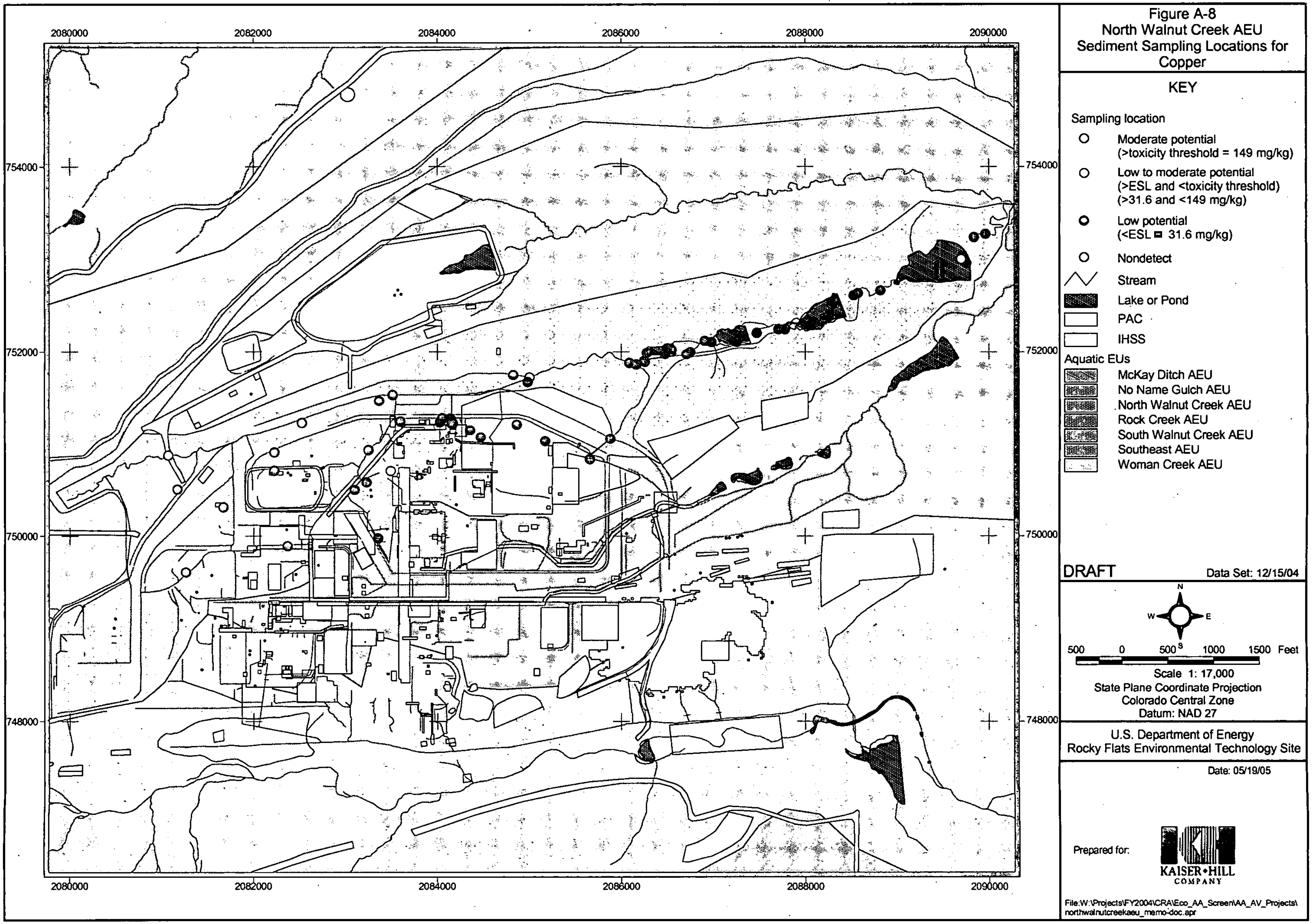

2080000
2082000
2084000
2086000
2088000
2090000
754000
752000
750000
748000
Figure A-8
North Walnut Creek AEU
Sediment Sampling Locations for Copper
KEY
Sampling location
Moderate potential
(>toxicity threshold = 149 mg/kg)
Low to moderate potential
(>ESL and <toxicity threshold)
(>31.6 and <149 mg/kg)
Low potential
(<ESL = 31.6 mg/kg)
Nondetect
Stream
Lake or Pond
PAC
IHSS
Aquatic EUs
McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU
DRAFT
Data Set: 12/15/04
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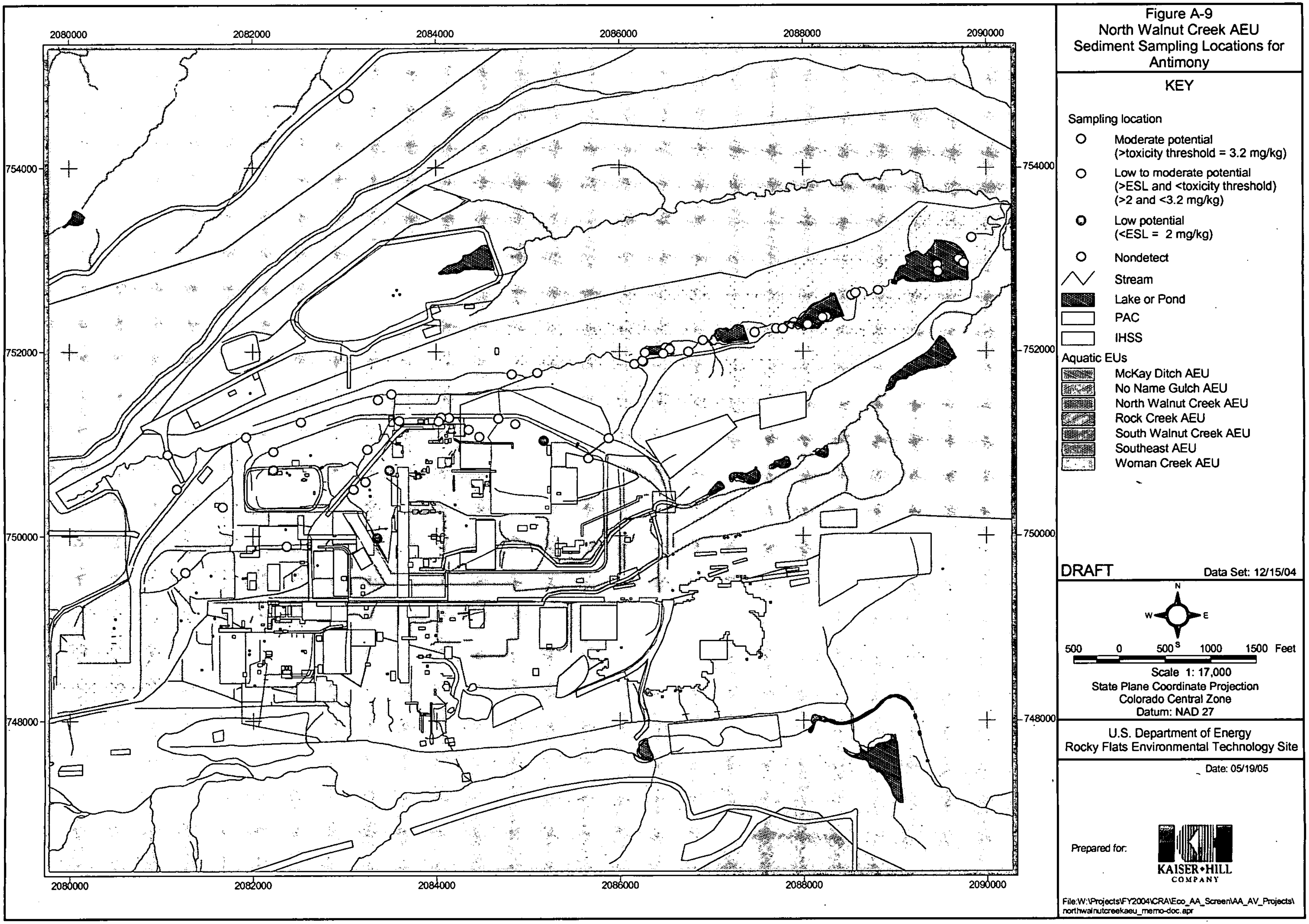

Figure A-9
North Walnut Creek AEU
Sediment Sampling Locations for Antimony
KEY
Sampling location
Moderate potential (>toxicity threshold = 3.2 mg/kg)
Low to moderate potential (>ESL and <toxicity threshold) (>2 and <3.2 mg/kg)
Low potential (<ESL = 2 mg/kg)
Nondetect
Stream
Lake or Pond
PAC
IHSS
Aquatic EUs
McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU
DRAFT
Data Set: 12/15/04
N
W
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S
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Scale 1: 17,000
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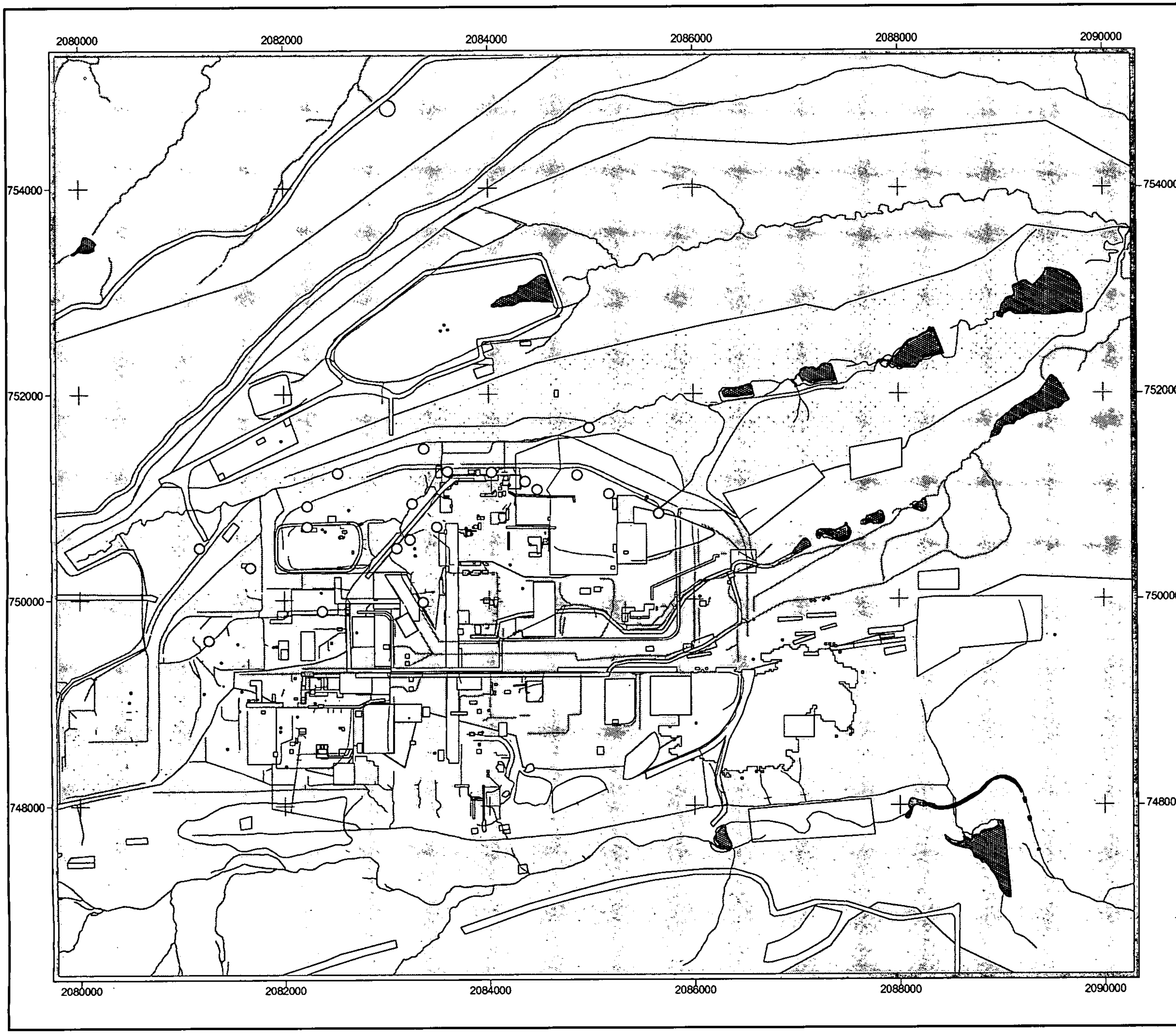

Figure A-10
North Walnut Creek AEU
Sediment Sampling Locations for Fluoride

KEY

Sampling location

- Moderate potential (>toxicity threshold = 7 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>0.01 and <7 mg/kg)
- Low potential (<ESL = 7 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

500 0 500 1000 1500 Feet

Scale 1: 17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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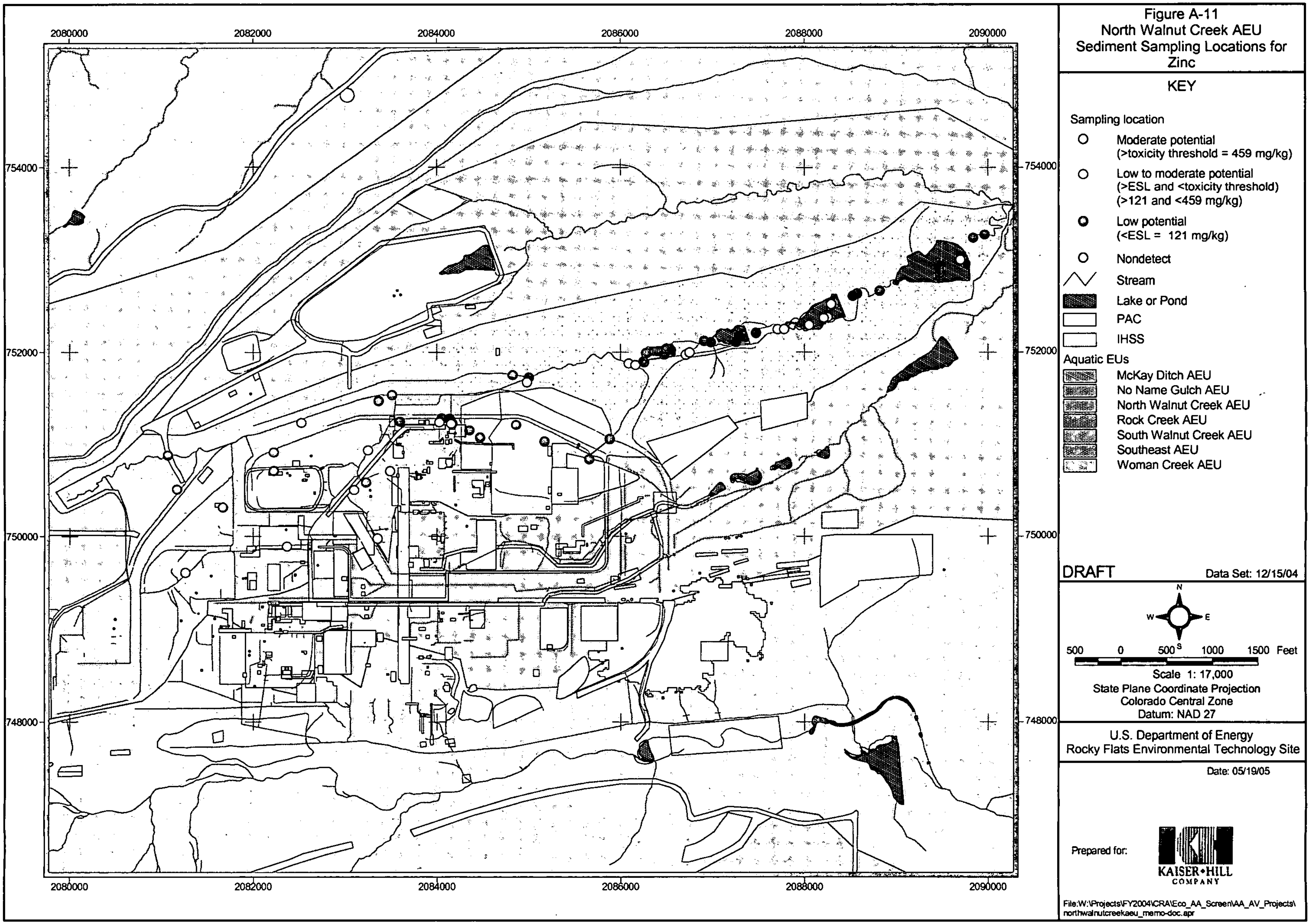
Figure A-11
North Walnut Creek AEU
Sediment Sampling Locations for
Zinc
KEY
Sampling location
Moderate potential
(>toxicity threshold = 459 mg/kg)
Low to moderate potential
(>ESL and <toxicity threshold)
(>121 and <459 mg/kg)
Low potential
(<ESL = 121 mg/kg)
Nondetect
Stream
Lake or Pond
PAC
IHSS
Aquatic EUs
McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU
DRAFT
Data Set: 12/15/04
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500 0 500 1000 1500 Feet
Scale 1: 17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
Date: 05/19/05
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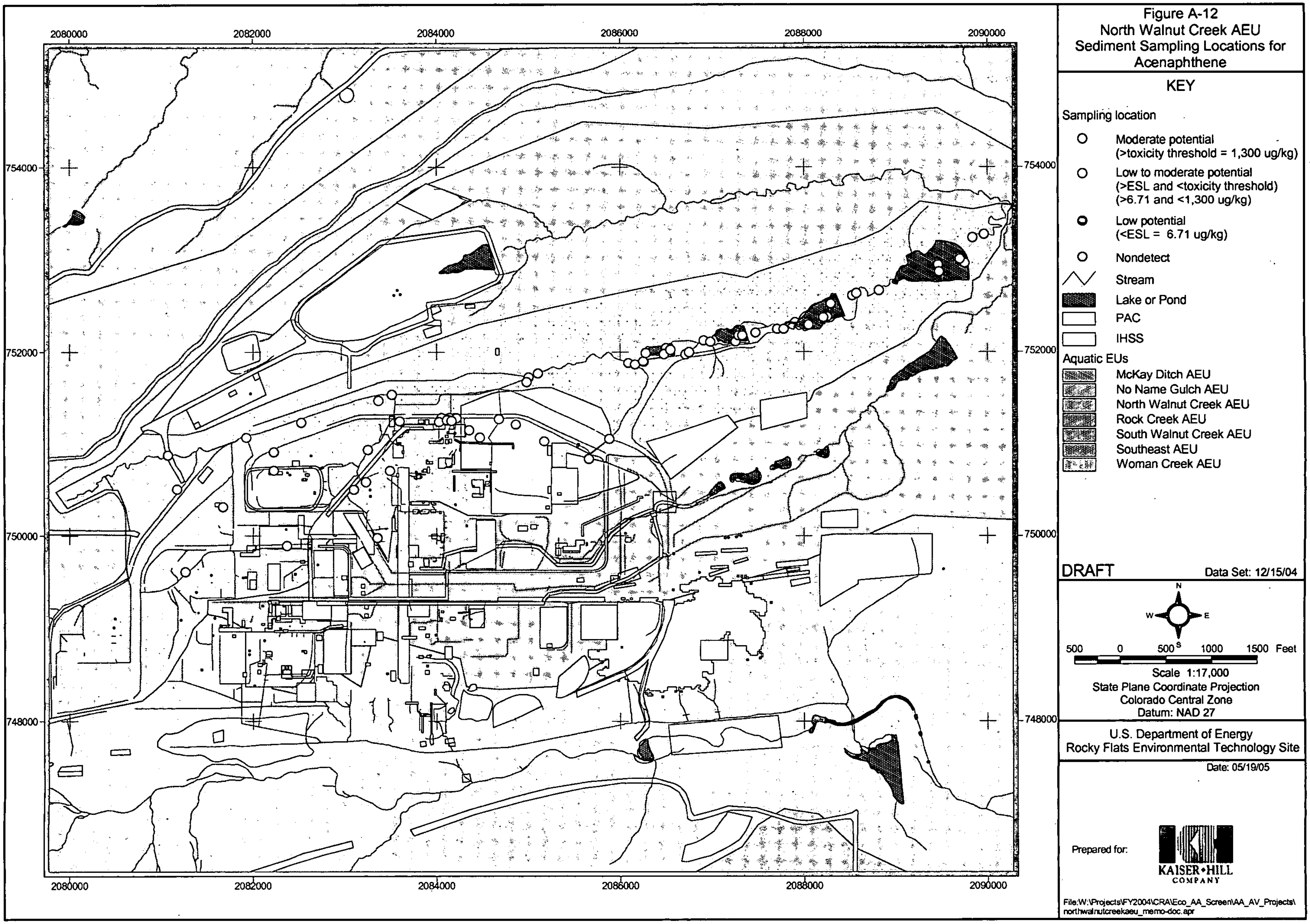
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748000
Figure A-12
North Walnut Creek AEU
Sediment Sampling Locations for
Acenaphthene
KEY
Sampling location
Moderate potential
(>toxicity threshold = 1,300 ug/kg)
Low to moderate potential
(>ESL and <toxicity threshold)
(>6.71 and <1,300 ug/kg)
Low potential
(<ESL = 6.71 ug/kg)
Nondetect
Stream
Lake or Pond
PAC
IHSS
Aquatic EUs
McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU
DRAFT
Data Set: 12/15/04
N
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Feet
Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
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COMPANY
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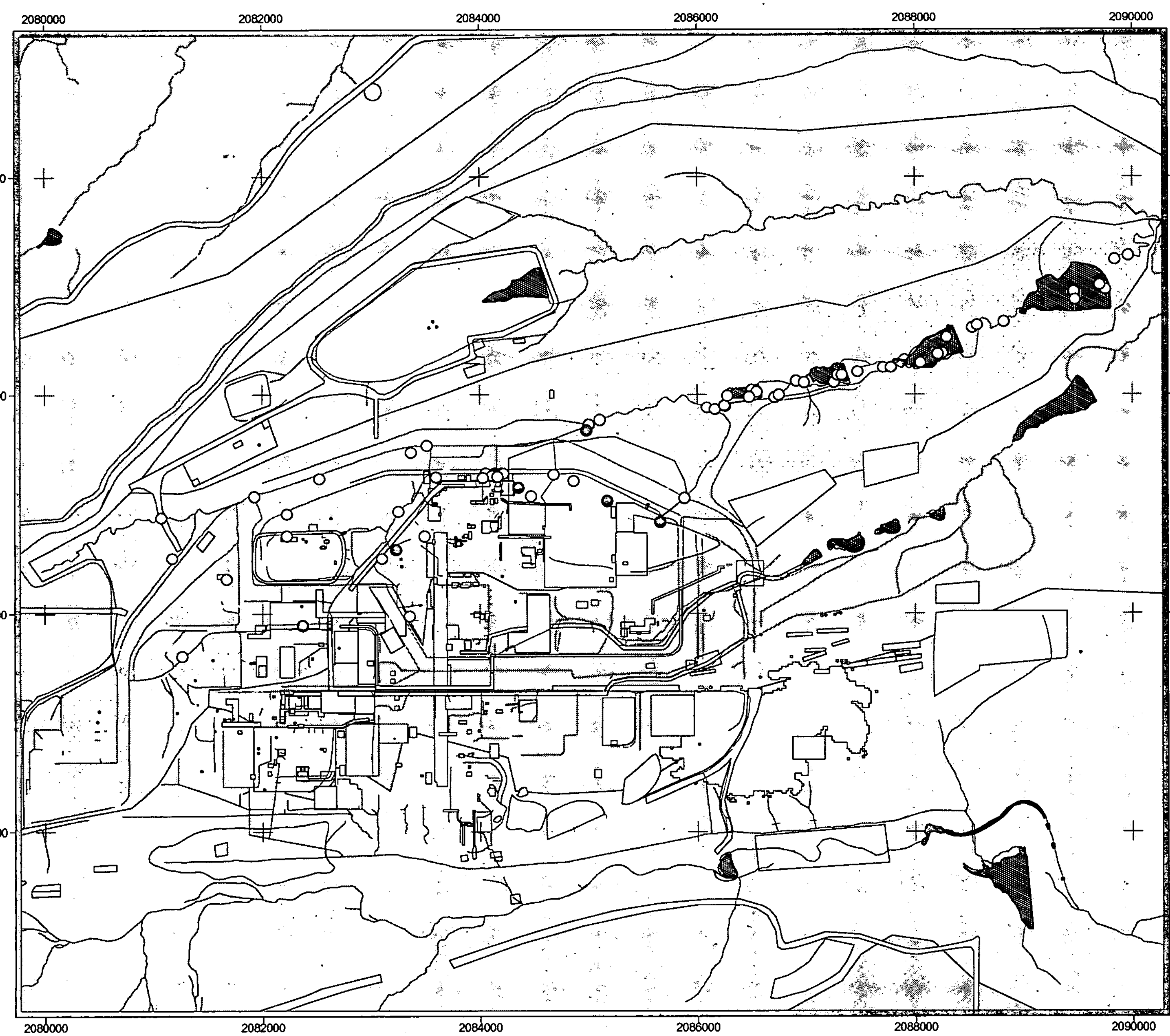
Figure A-13
North Walnut Creek AEU
Sediment Sampling Locations for
Anthracene



KEY

Sampling location

- Moderate potential (>toxicity threshold = 845 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>57.2 and <845 ug/kg)
- Low potential (<ESL = 57.2 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

500 0 500 1000 1500 Feet

Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
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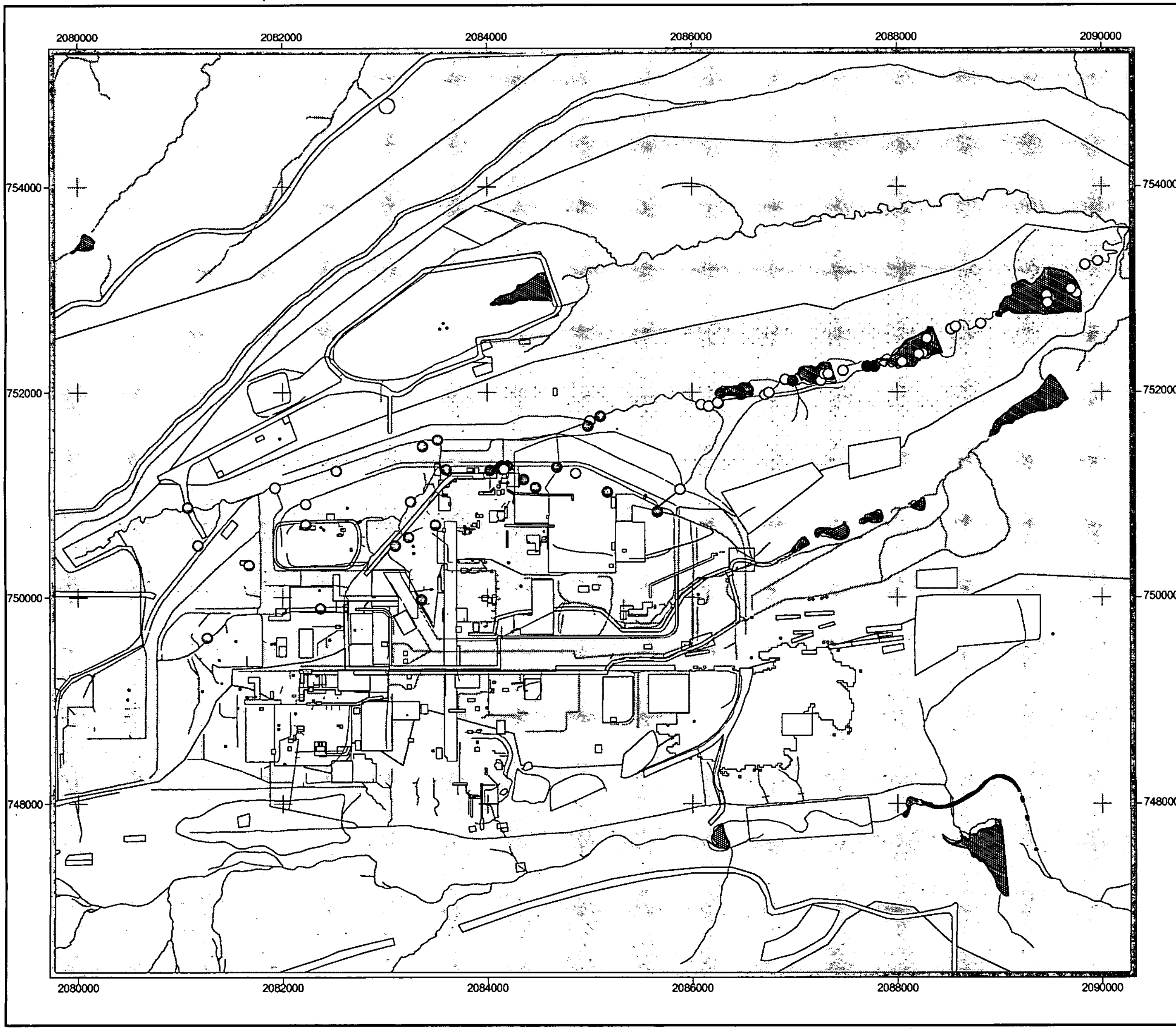

Figure A-14
North Walnut Creek AEU Sediment Sampling Locations for Benzo(a)anthracene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,050 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>108 and <1,050 ug/kg)
- Low potential (<ESL = 108 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

500 0 500 1000 1500 Feet

Scale 1:17,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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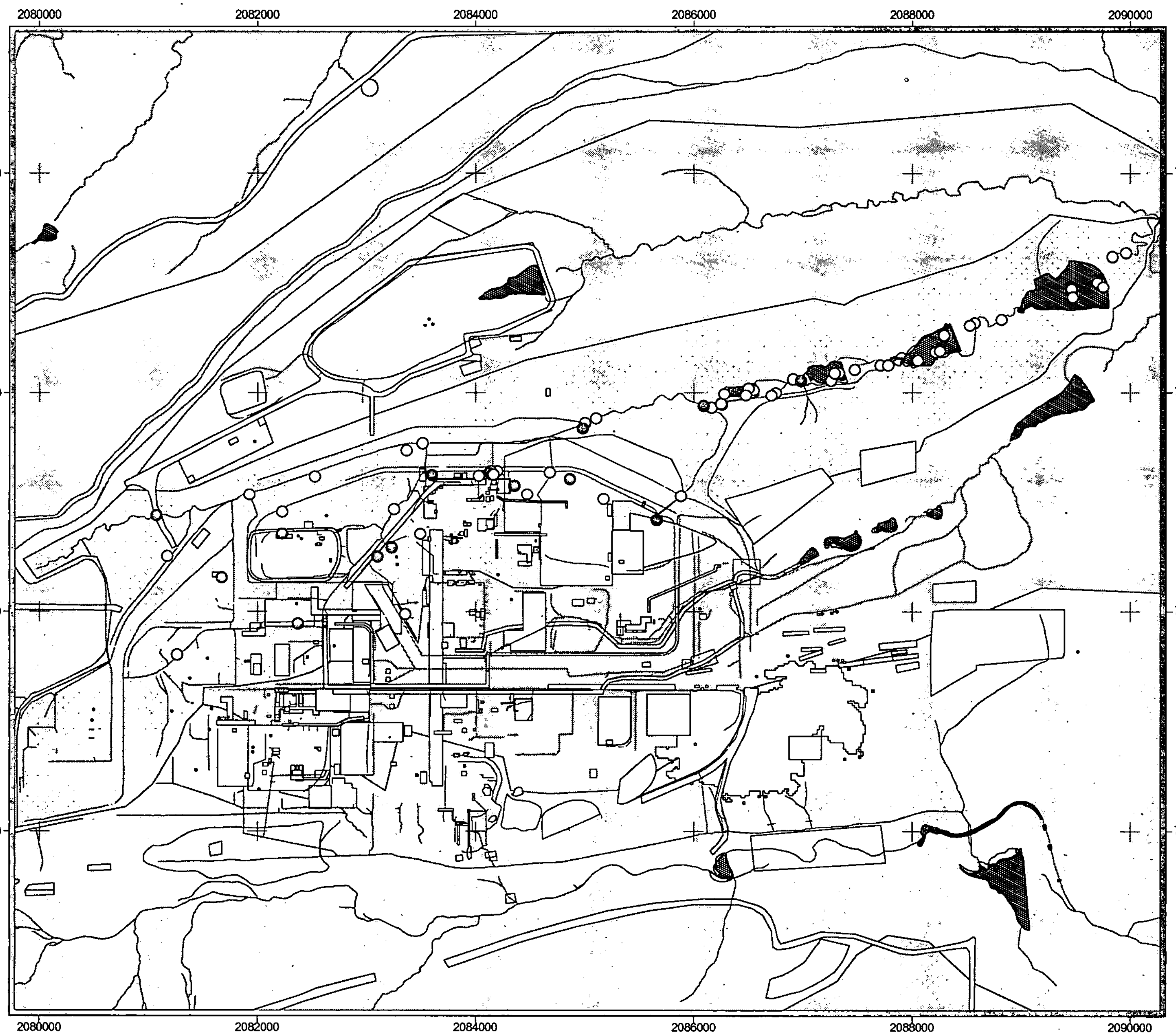

Figure A-15
North Walnut Creek AEU
Sediment Sampling Locations for
Benzo(a)pyrene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,450 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>150 and <1,450 ug/kg)
- Low potential (<ESL = 150 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

500 0 500 1000 1500 Feet

Scale 1: 17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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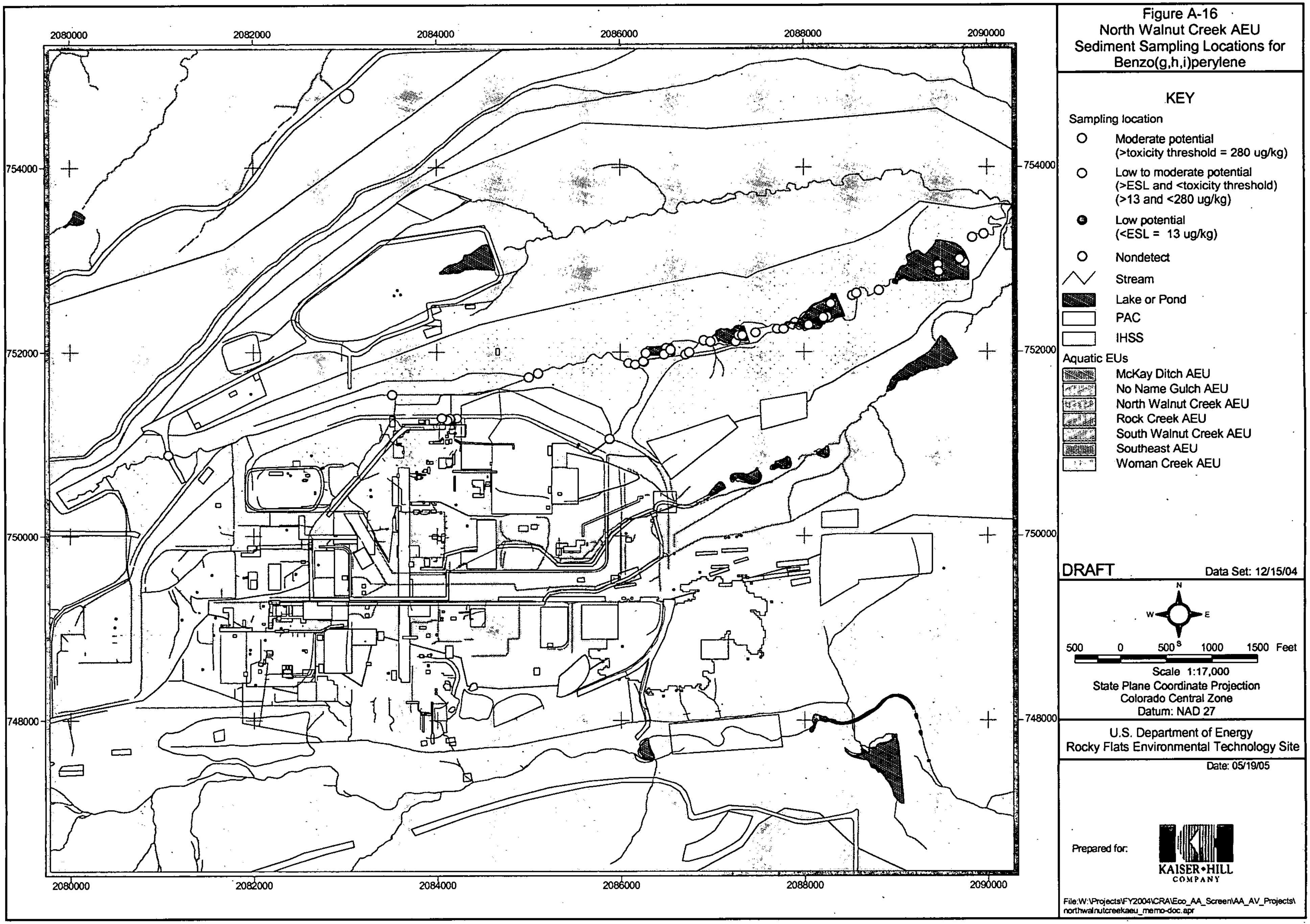

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2082000
2084000
2086000
2088000
2090000
754000
752000
750000
748000
Figure A-16
North Walnut Creek AEU
Sediment Sampling Locations for
Benzo(g,h,i)perylene
KEY
Sampling location
Moderate potential
(>toxicity threshold = 280 ug/kg)
Low to moderate potential
(>ESL and <toxicity threshold)
(>13 and <280 ug/kg)
Low potential
(<ESL = 13 ug/kg)
Nondetect
Stream
Lake or Pond
PAC
IHSS
Aquatic EUs
McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU
DRAFT
Data Set: 12/15/04
N
W
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S
500 0 500 1000 1500 Feet
Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
Date: 05/19/05
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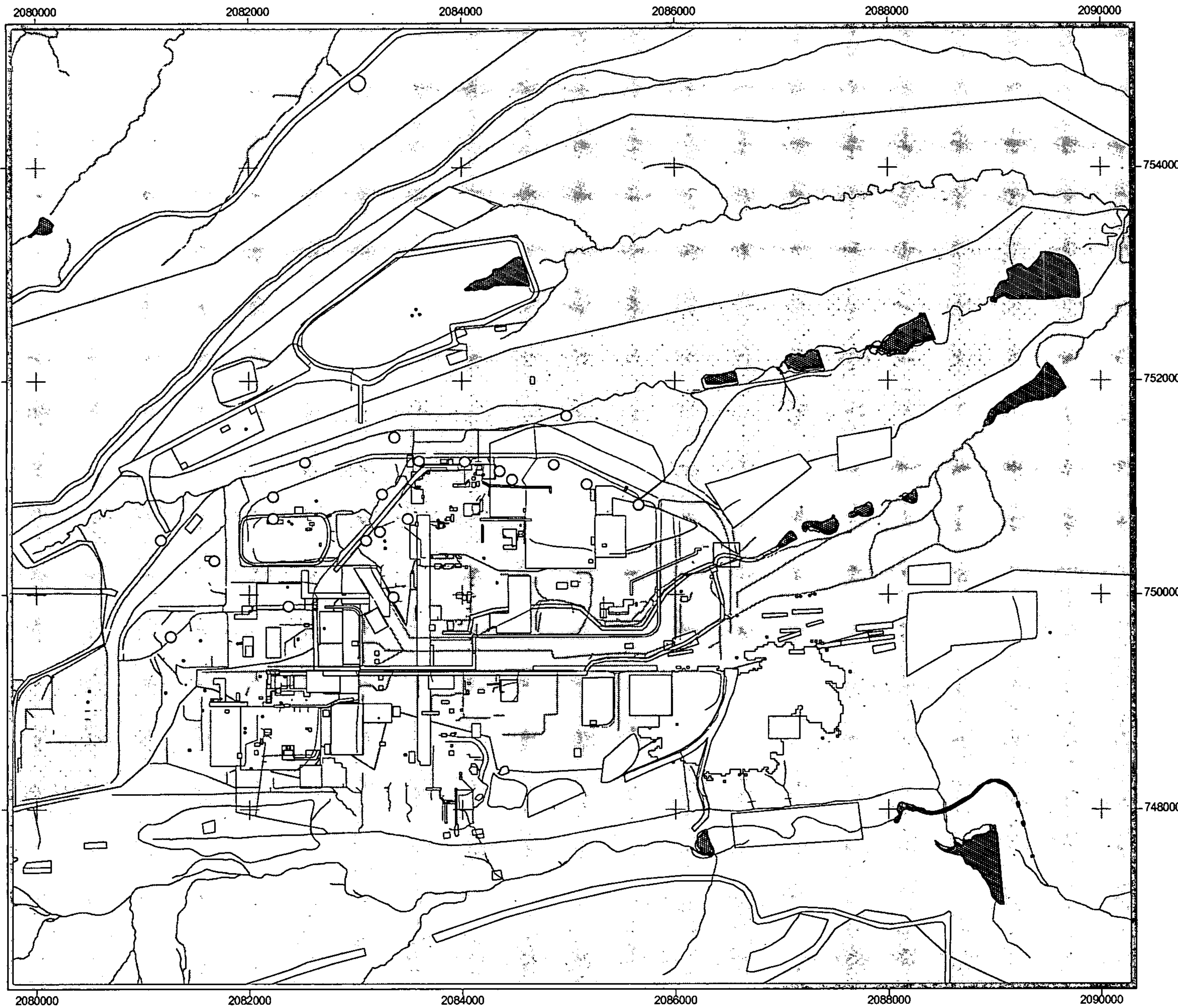

Figure A-17
North Walnut Creek AEU
Sediment Sampling Locations for
Carbazole

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,600 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>25.2 and <1,600 ug/kg)
- Low potential (<ESL = 25.2 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N S W E

500 0 500 1000 1500 Feet

Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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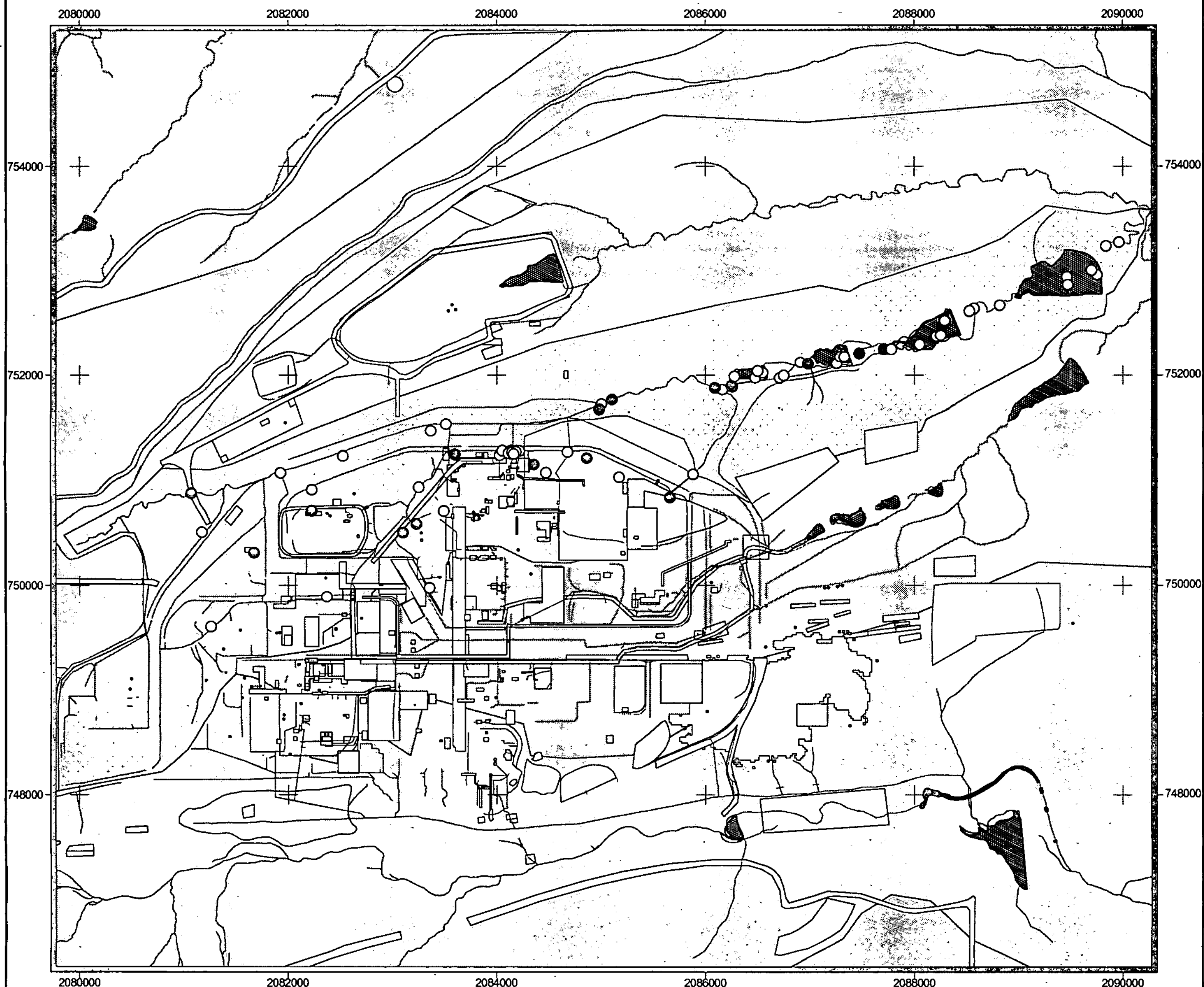

Figure A-18
North Walnut Creek AEU Sediment Sampling Locations for Chrysene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,290 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>166 and <1,290 ug/kg)
- Low potential (<ESL = 166 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

500 0 500 1000 1500 Feet

Scale 1: 17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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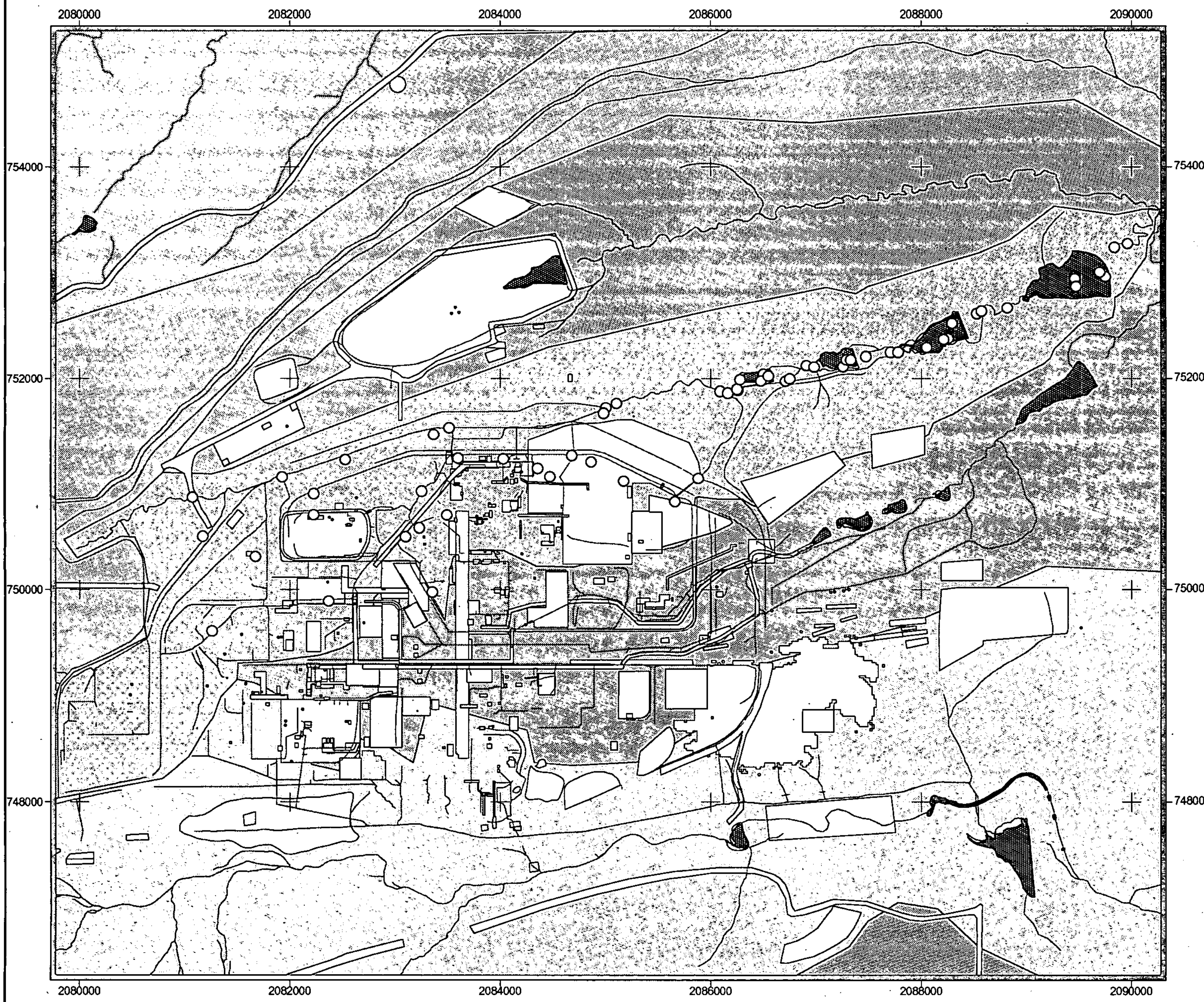

Figure A-19
North Walnut Creek AEU
Sediment Sampling Locations for Dibenz(a,h)anthracene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 135 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>33 and <135 ug/kg)
- Low potential (<ESL = 33 ug/kg)
- Nondetect

Stream

Lake or Pond

PAC

IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N S E W

500 0 500 1000 1500 Feet

Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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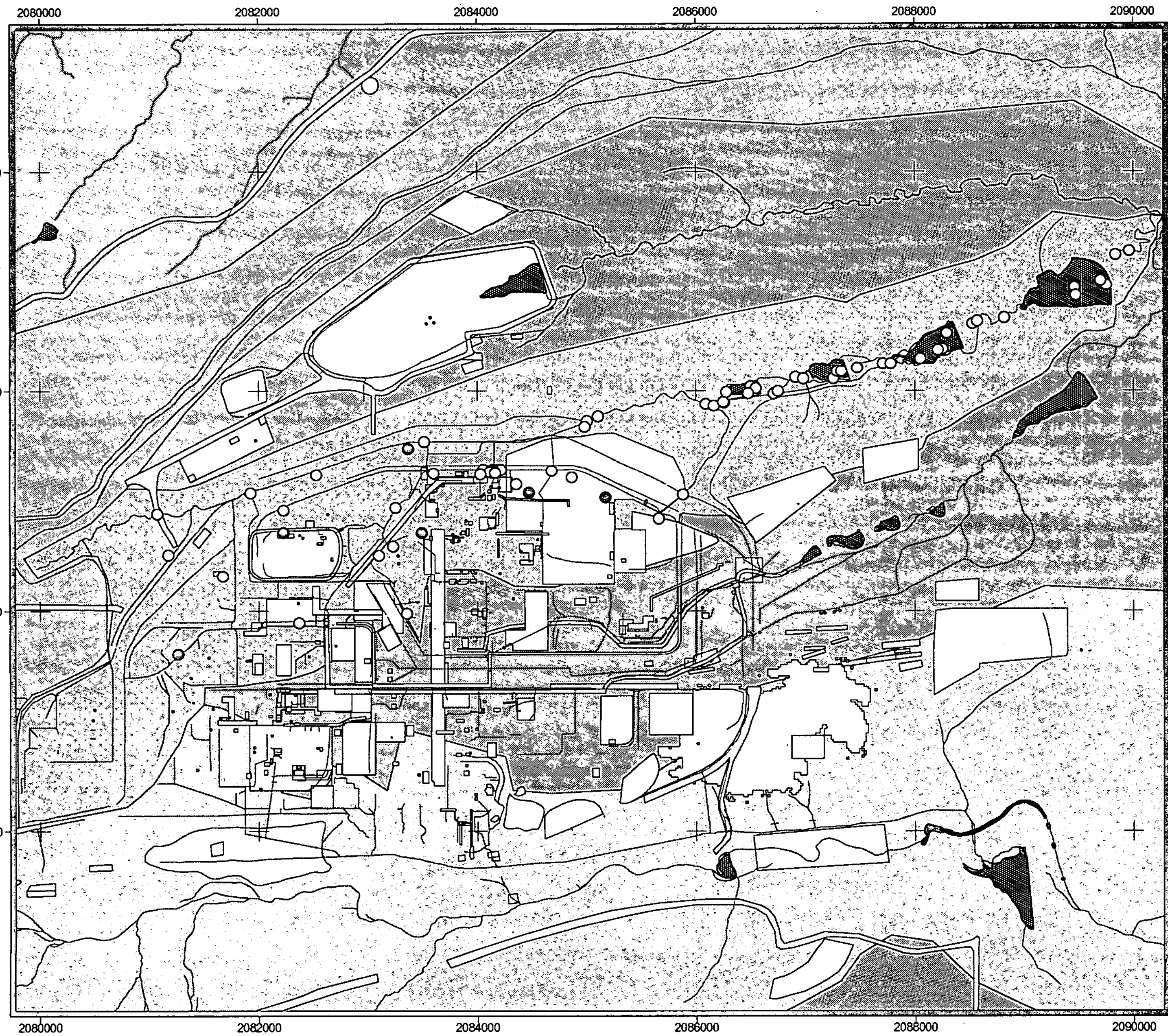

Figure A-20
North Walnut Creek AEU
Sediment Sampling Locations for
Fluorene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 536 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>77.4 and <536 ug/kg)
- Low potential (<ESL = 77.4 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

N S E W

500 0 500 1000 1500 Feet

Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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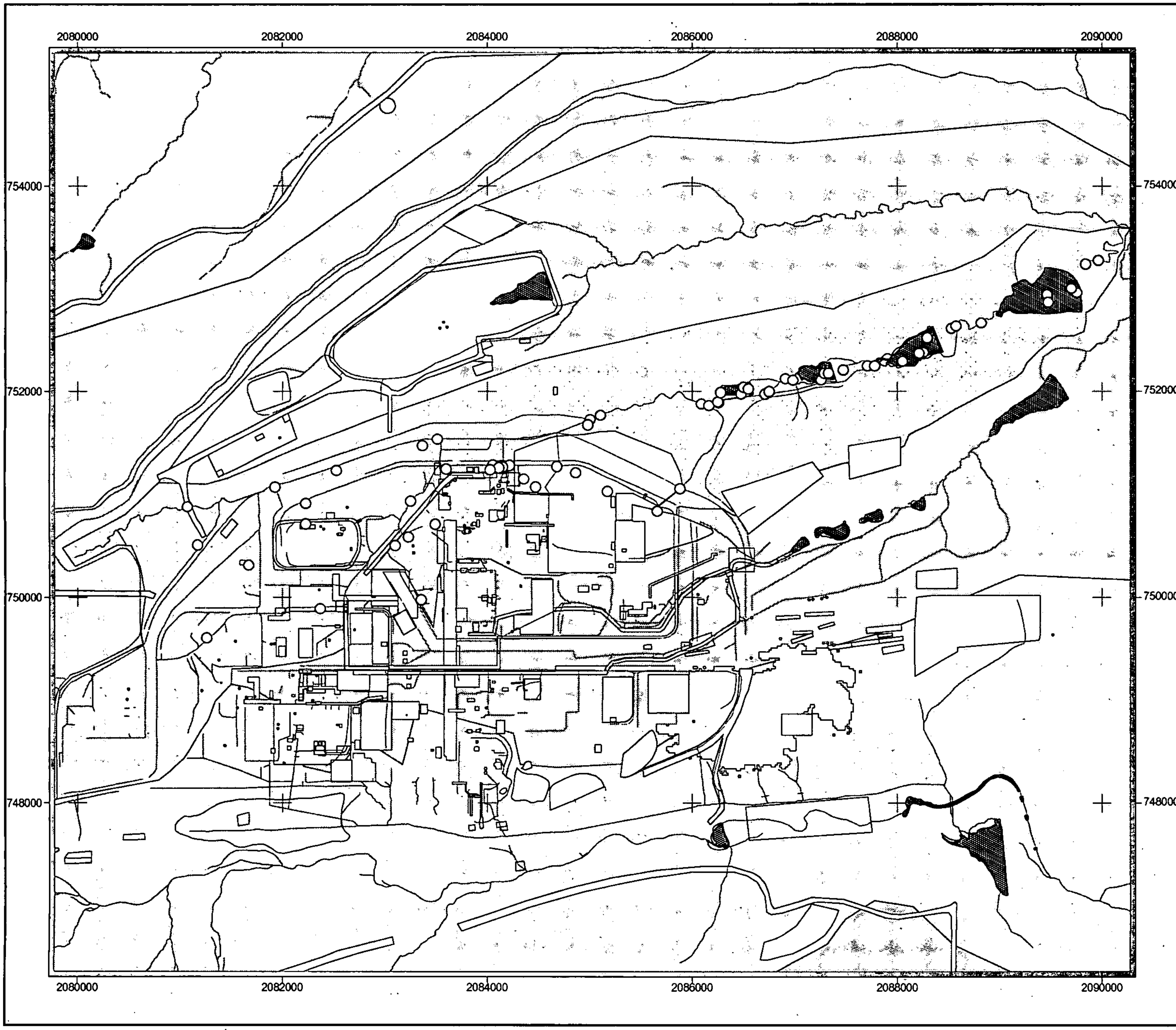

Figure A-21
North Walnut Creek AEU
Sediment Sampling Locations for
Indeno(1,2,3-cd)pyrene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 250 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>17 and <250 ug/kg)
- Low potential (<ESL = 17 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

N W E S

500 0 500 1000 1500 Feet

Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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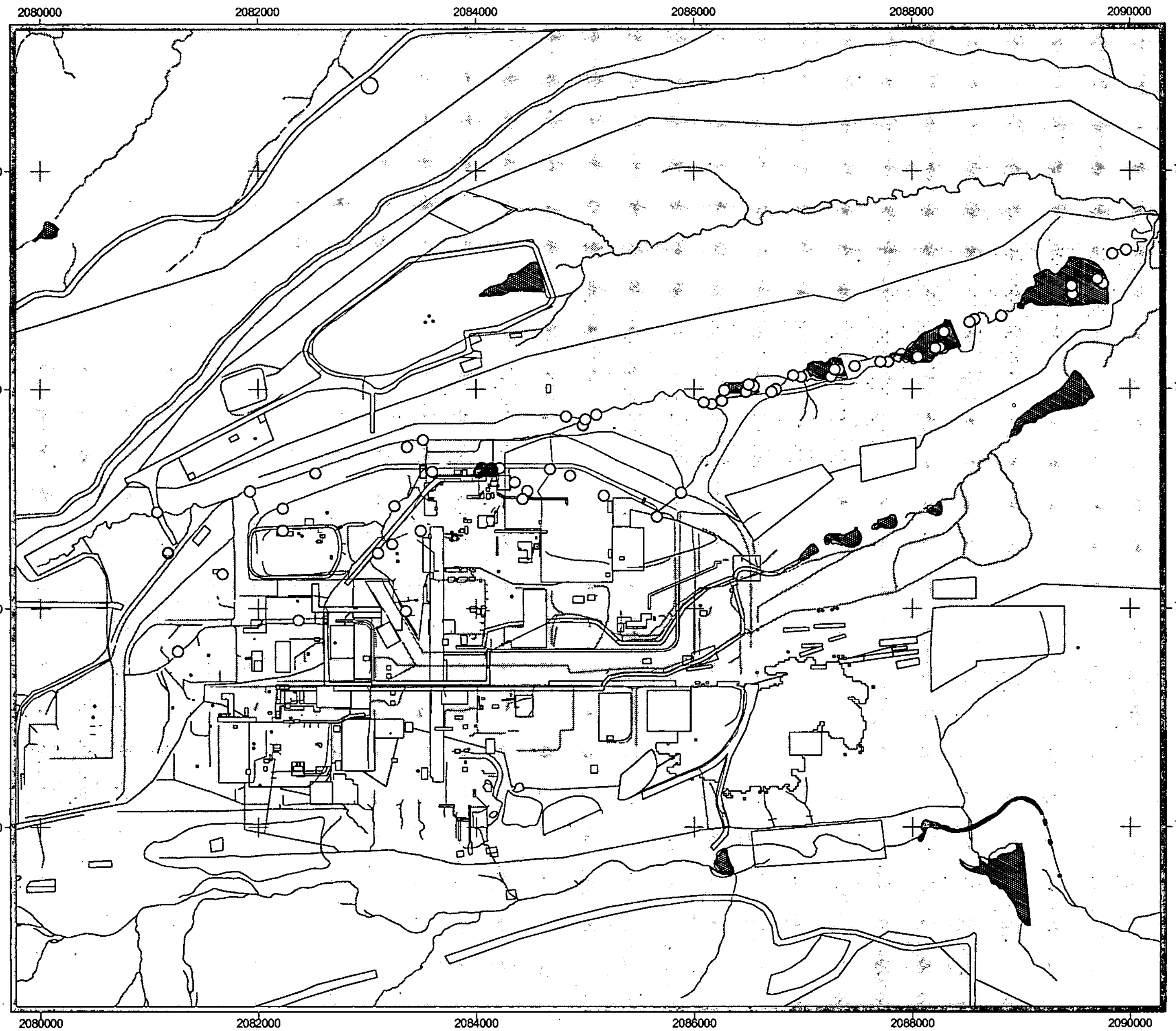
Figure A-22
North Walnut Creek AEU
Sediment Sampling Locations for Naphthalene



KEY

Sampling location

- Moderate potential (>toxicity threshold = 561 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>176 and <561 ug/kg)
- Low potential (<ESL = 176 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

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500 0 500 1000 1500 Feet

Scale 1: 17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Date: 05/19/05

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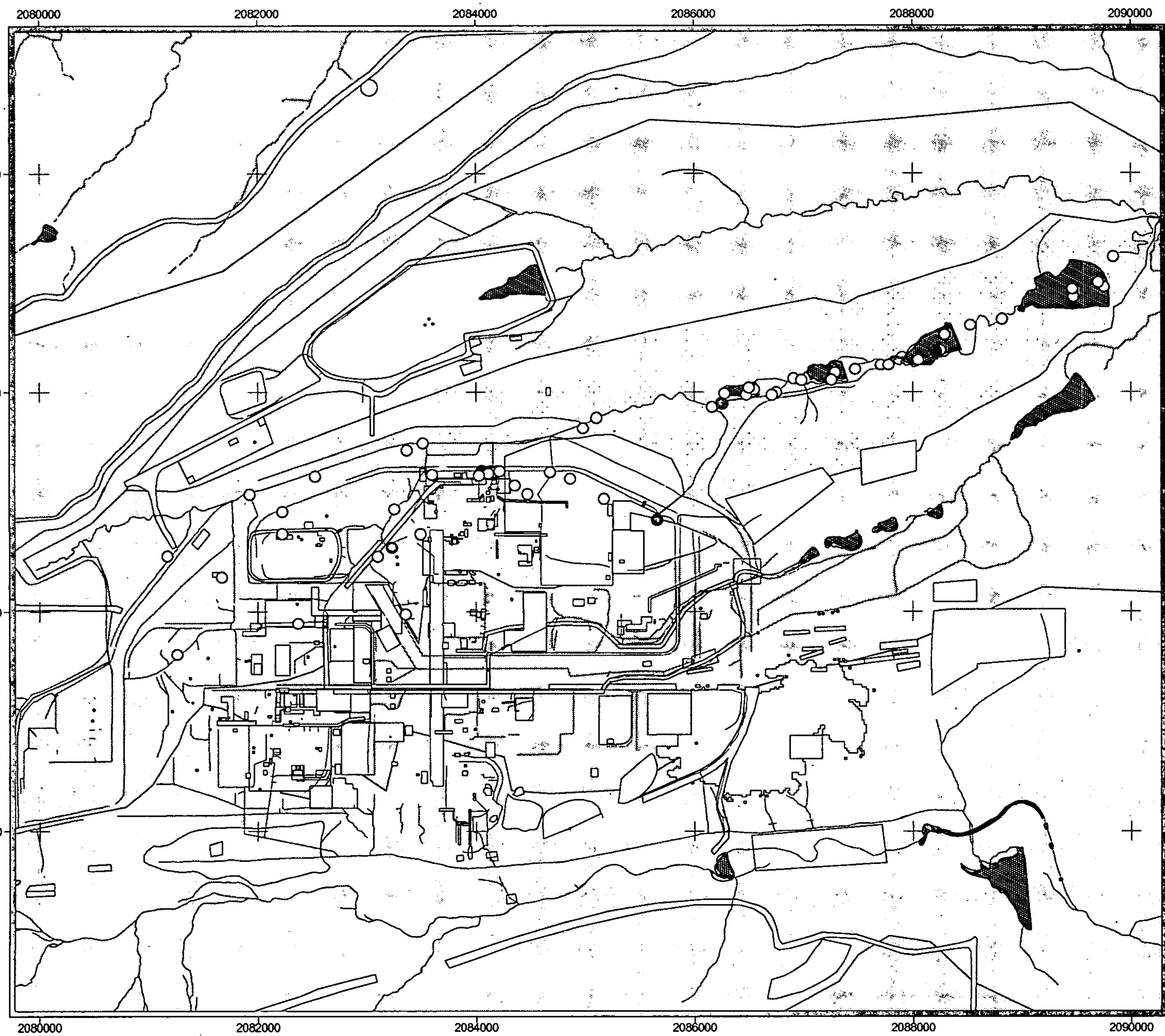
Figure A-23
North Walnut Creek AEU Sediment Sampling Locations for PCB-1254



KEY

Sampling location
- Moderate potential (>toxicity threshold = 300 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>60 and <300 ug/kg)
- Low potential (<ESL = 60 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

N E S W

500 0 500 1000 1500 Feet

Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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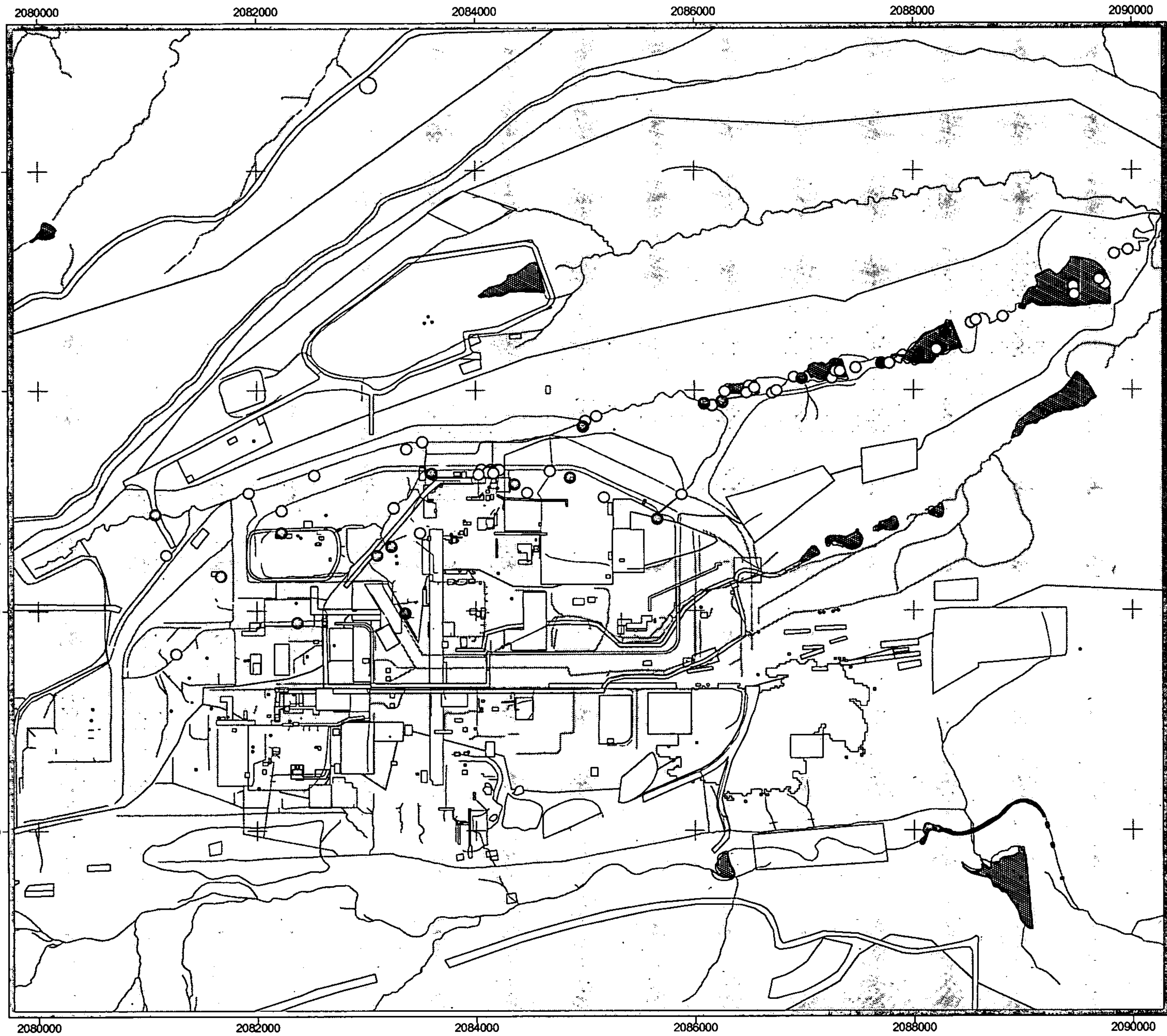

Figure A-24
North Walnut Creek AEU
Sediment Sampling Locations for
Phenanthrene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,170 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>204 and <1,170 ug/kg)
- Low potential (<ESL = 204 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

500 0 500 1000 1500 Feet

Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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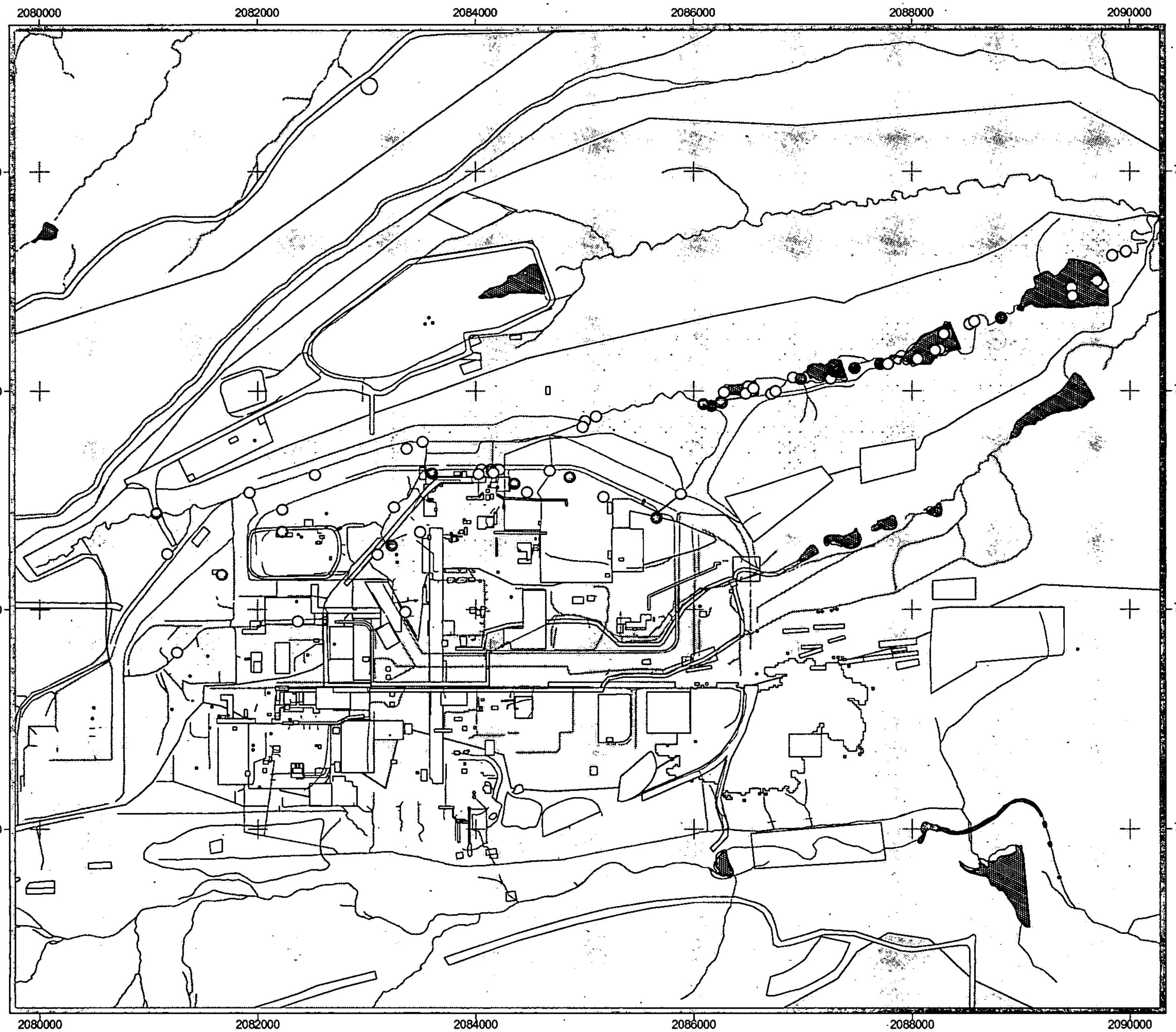

Figure A-25
North Walnut Creek AEU
Sediment Sampling Locations for
Pyrene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,520 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>195 and <1,520 ug/kg)
- Low potential (<ESL = 195 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

500 0 500 1000 1500 Feet

Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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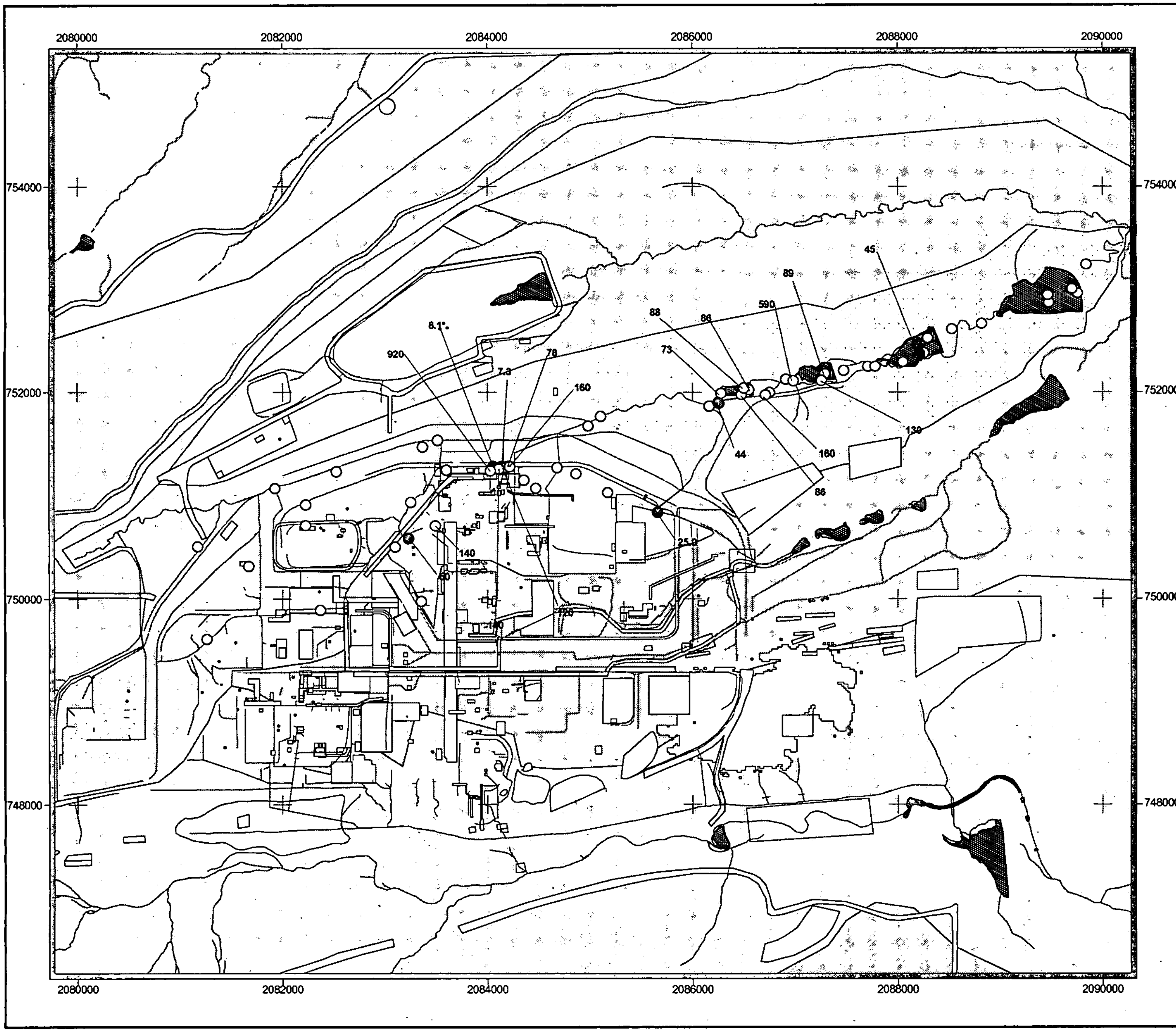

Figure A-26
North Walnut Creek AEU
Surface Sediment Sampling
Location Results for PCB-1254

KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Moderate potential (>toxicity threshold = 300 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>60 and <300 ug/kg)
- Low potential (<ESL = 60 ug/kg)
- Nondetect
- Stream
- Lake or pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

500 0 500 1000 1500 Feet

Scale 1:17,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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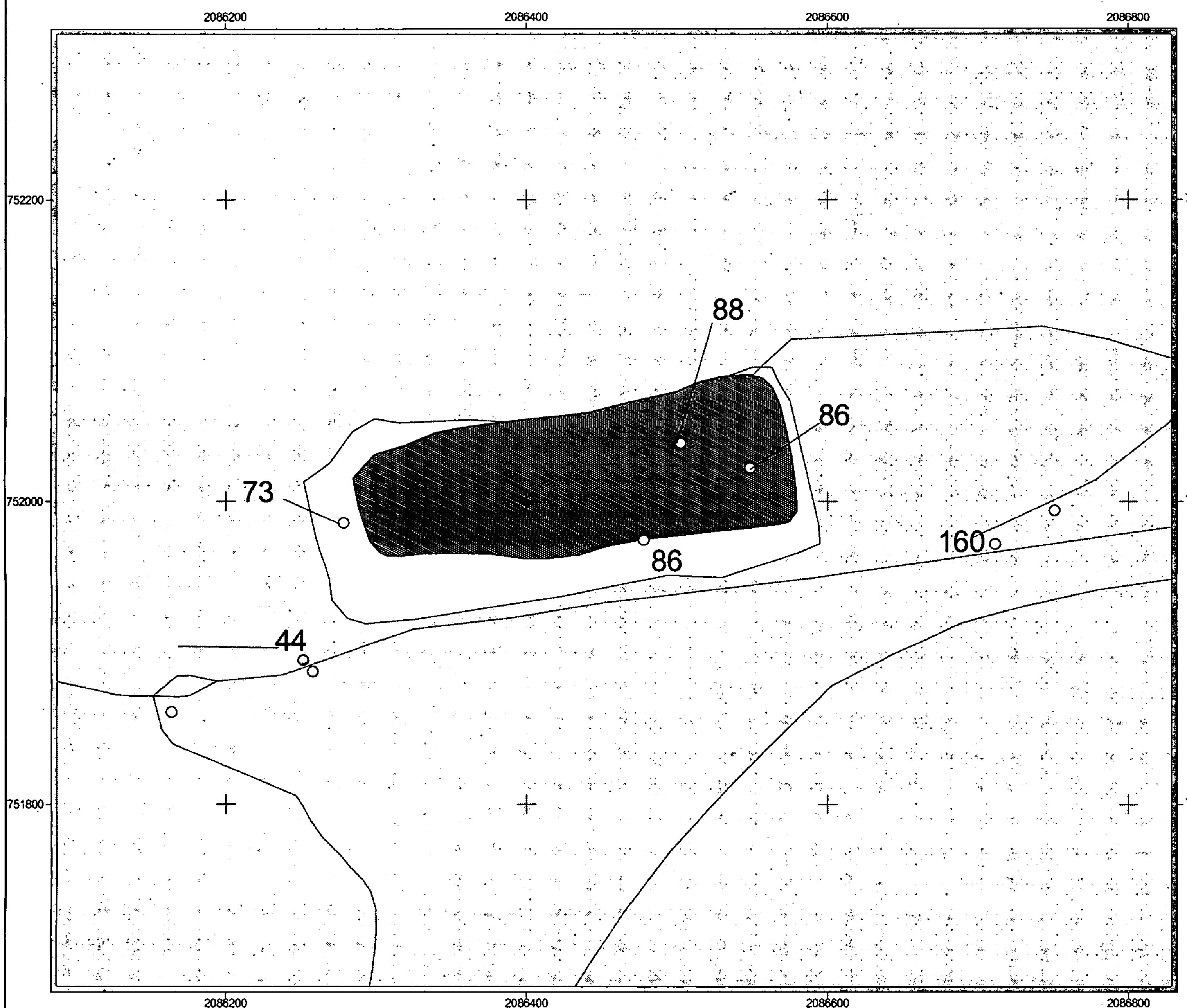

Figure A-27
North Walnut Creek AEU Pond A-1 Surface Sediment Sampling Location Results for PCB-1254

KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Moderate potential (>toxicity threshold = 300 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>60 and <300 ug/kg)
- Low potential (<ESL = 60 ug/kg)
- Nondetect

Stream

Lake or pond

PAC

IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

40 0 40 80 Feet

Scale 1:1,200

State Plane Coordinate Projection

Colorado Central Zone

Datum: NAD 27

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112

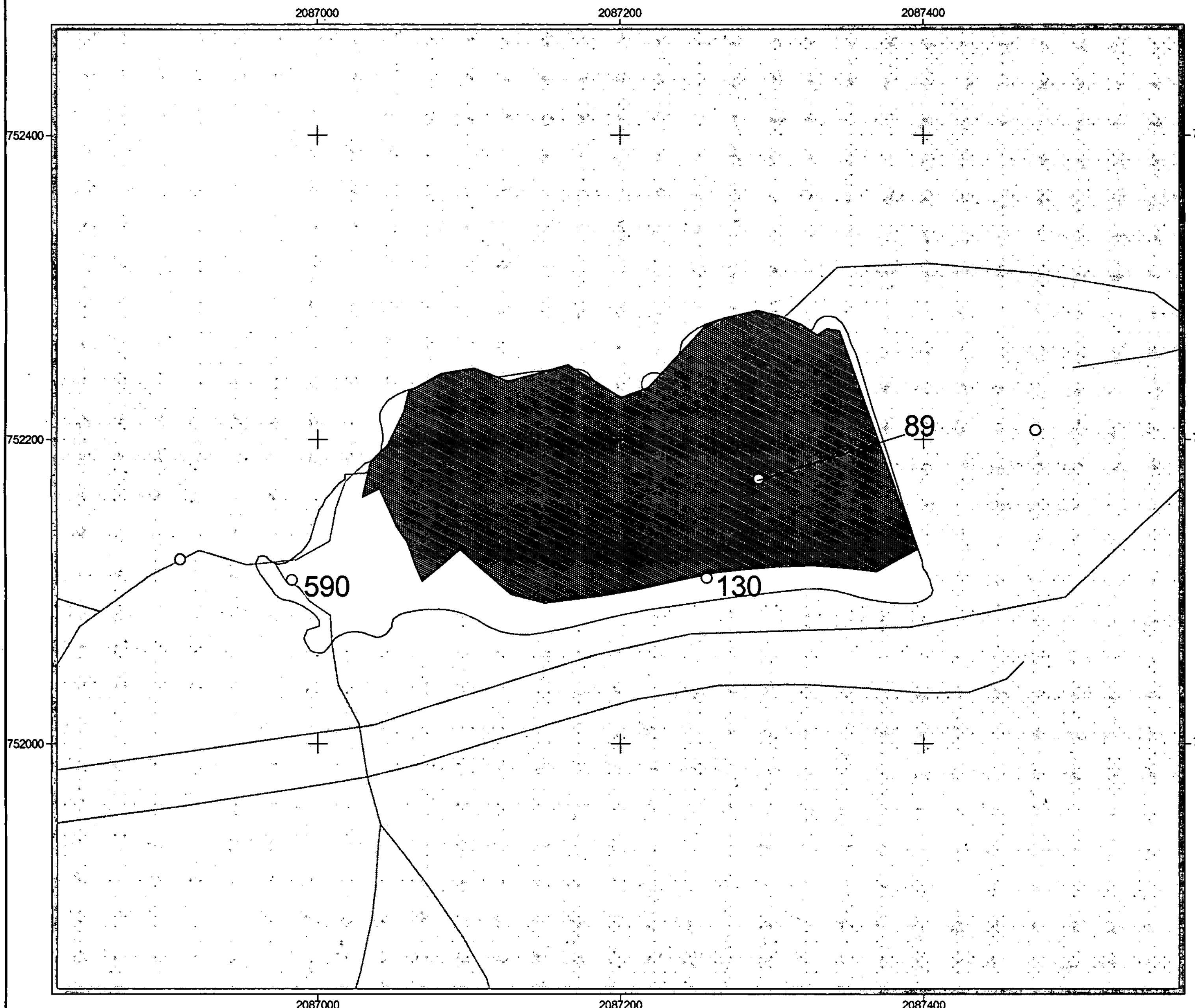

Figure A-28
North Walnut Creek AEU Pond A-2
Surface Sediment Sampling Location
Results for PCB-1254

KEY

1.0 Sample concentration (ug/kg)

Sampling location

Moderate potential (>toxicity threshold = 300 ug/kg)

Low to moderate potential (>ESL and <toxicity threshold) (>60 and <300 ug/kg)

Low potential (<ESL = 60 ug/kg)

Nondetect

Stream

Lake or pond

PAC

IHSS

Aquatic EUs

McKay Ditch AEU

No Name Gulch AEU

North Walnut Creek AEU

Rock Creek AEU

South Walnut Creek AEU

Southeast AEU

Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

40 0 40 80 Feet

Scale 1:1,200

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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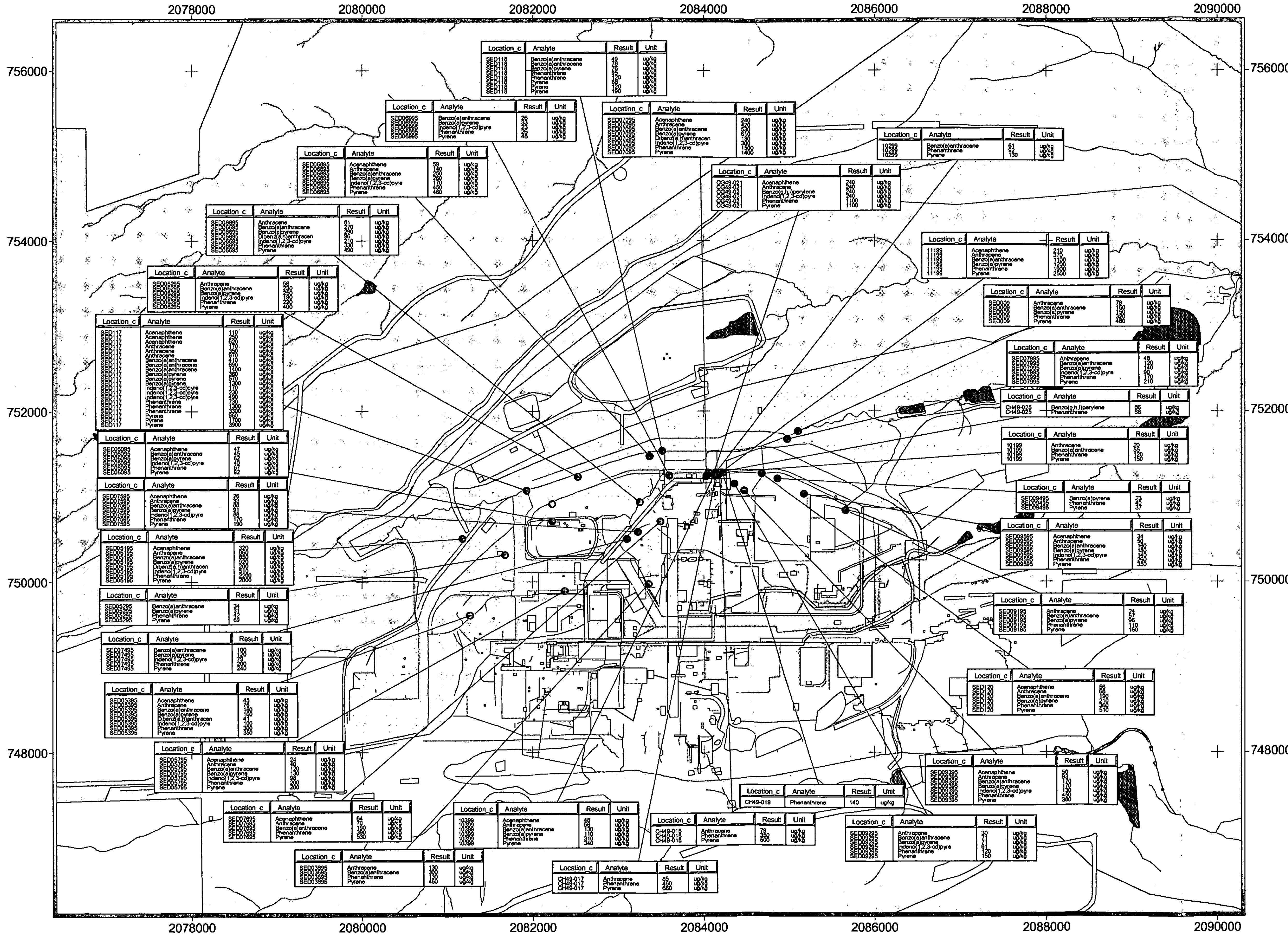
Figure A-29
North Walnut Creek AEU Surface Sediment Sampling Location Results for PAHs



KEY

- Surface sediment sampling location
- Stream
- Lake
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N
W E
S

700 0 700 1400 Feet

Scale = 1: 14,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

KAISER•HILL COMPANY

File:W:\Projects\Fy2004\CRA\Eco_AA_Screen\AA_AV_Projects\northwalnutcreekaeu_memo-doc.apr

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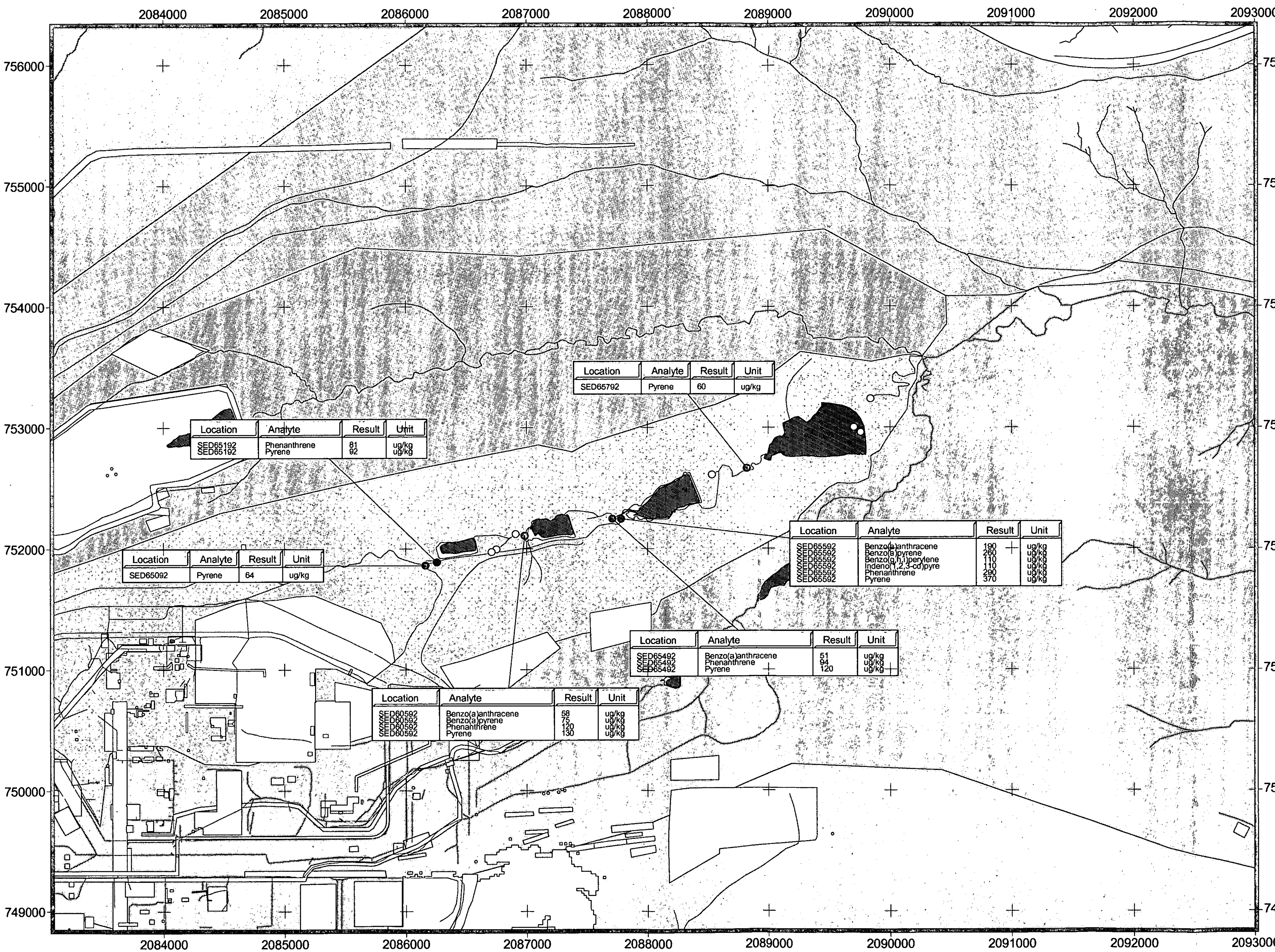

Figure A-30
North Walnut Creek AEU Surface Sediment Sampling Location Results for PAHs

KEY

- Surface sediment sampling location
- Stream
- Lake
- PAC
- IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

500 0 500 1000 Feet

Scale = 1: 10,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

KAISER•HILL COMPANY

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ATTACHMENT 1

AQUATIC ECOSYSTEM HEALTH ASSESSMENT – NORTH WALNUT CREEK AQUATIC EXPOSURE UNIT

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ACRONYMS AND ABBREVIATIONS

AAI	Aquatic Associates, Inc.
AEU	Aquatic Exposure Unit.
ECOPC	ecological contaminant of potential concern
EU	Exposure Unit
HQ	hazard quotient
IA	Industrial Area
K-H	Kaiser-Hill Company L.L.C.
mg/L	milligrams per liter
RFETS or Site	Rocky Flats Environmental Technology Site

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AQUATIC ECOSYSTEM HEALTH

The health of aquatic life within North Walnut Creek can be potentially affected by contaminants associated with Rocky Flats Environmental Technology Site (RFETS or Site) activities that were released into the creek or by the limits of the habitat itself. The potential effects attributable to the ecological chemicals of potential concern (ECOPCs) were evaluated using standard risk assessment methods. Additional steps involving the development of Hazard Quotients (HQs), and evaluation of the nature and extent of ECOPC occurrence, were also completed and discussed. This section summarizes documented studies that describe the aquatic ecosystem health within North Walnut Creek. This information was obtained from previous investigations and summarized to understand the overall condition of the drainage. Previous studies that characterized the aquatic ecosystem health were reviewed and summarized, as discussed below.

Baseline Biological Characterization of the Terrestrial and Aquatic Habitats at Rocky Flats Plant (DOE 1992) – A baseline study of terrestrial and aquatic environments at RFETS from 1990 to 1991 was conducted. Of the aquatic ecosystem, streams, impoundments, and wetlands were the major habitats studied. The aquatic habitats were found to have high species richness, an indication of a healthy ecosystem. Four different groups of organisms were studied: phytoplankton, periphyton, benthic macroinvertebrates, and fish.

The report documents that aquatic habitats at RFETS have a very high density of benthic macroinvertebrates. Fish species diversity in the semiarid climate is naturally low, due to the harsh environmental conditions (for example, intermittent streams) and the larger pools and ponds required to support fish populations. Nine species of fish were collected at RFETS, most are in the family *Cyprinidae* (minnow family, six species). Most species were found in pools or impoundments that offer refuge from annual drought conditions. Several ponds had very high populations of golden shiners and fathead minnows.

The authors report that the most disruptive environmental factor to aquatic communities at RFETS is the natural semiarid conditions. All streams have sections that are intermittent, while others are fed by groundwater seeps that keep sections perennial. Aquatic communities at RFETS thrive despite the environmental limitations. Many aquatic organisms present are adapted to low-stream flow conditions. These organisms are often classified as "tolerant" considering general water quality.

North Walnut Creek was modified into a series of retention ponds (the A-series ponds). These retention ponds and connecting stream network provide habitat for plants and animals adapted to the water level fluctuations. Benthic macroinvertebrate samples from Walnut Creek contained 59 taxa during fall sampling. *Diptera* had the highest species richness with 24 species. Two species of fish were collected from the A-series ponds: fathead minnow and golden shiner. No predatory fish were found.

Lower Walnut Creek Aquatic Sampling, Spring 1998 (Kaiser-Hill, L.L.C. 1998) – The objectives of this study of Lower Walnut Creek were to determine the quality of aquatic habitat, richness, and abundance of benthic macroinvertebrates; identify what fish species are present; determine the condition of the benthic macroinvertebrate and fish populations in Lower Walnut Creek; and compare these results to downstream areas. One

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site within RFETS was investigated, along with five others located east of the Site. The conclusions indicated aquatic life in Walnut Creek is limited by stream flow, which has been modified from natural flow conditions. However, the assessment presented findings of good habitat and a relatively healthy macroinvertebrate community, which equates to relatively good water quality. The study stated that the water quality is good in Walnut Creek and there are no indications that pollution is limiting aquatic life. The observed species are controlled/affected by the intermittent flows in the creek. The study recognized its limitations of being a single sampling event, and thus a "snap shot" of the creek condition, and recommended that further studies be completed.

Results of the Aquatic Monitoring Program In Big Dry Creek (Aquatic Associates, Inc. 1998) – This study summarizes the methods and findings of an aquatic monitoring program initiated in 1997 for Big Dry Creek to understand the ecology (baseline conditions) within the system. Water quality, benthic macroinvertebrates and fish were all sampled by Aquatic Associates, Inc. (AAI) and the Colorado Division of Wildlife. Findings from the report determined that the physical habitat and fluctuating stream flows most likely limit the macroinvertebrate community in Big Dry Creek, particularly in lower-gradient areas downstream from the Broomfield Treatment Plant where riffle habitats with cobble substrate are sparse and much of the streambed is channelized. The intermittent flows are also a significant controlling factor to the ecology.

Interim Report: Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, Golden, Colorado, 2001-2002 (DOE 2003) – The purpose of this study was to characterize the existing aquatic communities (fish and macroinvertebrates) and physical habitat conditions in the Walnut, Woman and Rock Creek drainages to provide a baseline for monitoring the potential influences of Site closure activities. Findings from the study indicated all streams at Rocky Flats are flow-limited. Perennial flows are typically in the upper reaches of all three drainages, and flows diminish considerably in downstream reaches where the streams become largely intermittent. In the upper reaches where flows are perennial, habitat assessment scores were generally highest indicating overall better habitat quality. In the effluent-dominated reach of North Walnut Creek, bank erosion resulting in poor bank stability and sediment inputs to the stream is the main problem that negatively affects physical habitat and aquatic life. Fish abundance and distribution in these streams are severely limited due to the obvious lack of permanent water.

The macroinvertebrate community was observed as being rich and diverse, and composed mainly of hardy and tolerant species. The dominant organisms found in Walnut Creek were similar to the other RFETS drainages, with *dipterans* most abundant in Walnut Creek. *Ephemeroptera* were relatively abundant throughout the drainages, and included moderate to tolerant taxa. *Trichoptera* (caddisflies) in Walnut Creek were generally present in higher numbers compared with other RFETS drainages, likely due to the effluent-dominated flows. Amphipods are also found in higher numbers in Walnut Creek in the slower-moving or standing-water environments provided by the ponds.

Supplemental Biological and Selected Water Quality Data Exploration, 1997 - 2001 (Wright Water Engineers Inc. 2003) – The purpose of this study was to conduct an integrated analysis of habitat, macroinvertebrate, fish, flow, and select water quality parameters on the main stem of Big Dry Creek. This was undertaken to develop an understanding of the factors influencing aquatic life in the creek and determine whether a more stringent un-ionized ammonia standard was necessary to protect the Johynny darter. This evaluation compiled 5 years of biological data. The results indicated effects possibly due to drought conditions. The upstream locations generally have higher-quality fish and benthic communities than downstream. Upstream locations also generally have higher habitat scores, better water quality, and lower flows. Un-ionized ammonia does not appear to be affecting the fish and benthic communities, based on concentrations present in the creek during spring and fall of the last 5 years (range from 0.0 to 0.11 milligrams per liter [mg/L]). Un-ionized ammonia concentrations in the creek are generally below the stream standard.

SUMMARY OF ECOSYSTEM HEALTH

These reports support the conclusion that aquatic habitats in North Walnut Creek are limited by flows that have been modified from natural flow conditions (K-H 1998; DOE 2003). These conditions control the habitats and associated aquatic life found in this Aquatic Exposure Unit (EU) (AEU). North Walnut Creek, with its ponds, is highly influenced historically by the effluent-driven flows and pond maintenance. Pond A-1 is hydrologically isolated from Industrial Area (IA) runoff and only receives water within its small basins during storm events. Effluent from the IA is carried around Pond A-1 to Pond A-2. Given this design, under normal operating conditions Pond A-1 has limited incoming flows and is often dry. The lower ponds tend to have perennial habitats and can support more diverse macroinvertebrate communities. The terminal pond, Pond A-4, is continually drawn down during periodic discharges to lower Walnut Creek. All these factors in North Walnut Creek limit aquatic habitats in this AEU.

Within the aquatic habitats present in North Walnut Creek, whether perennial or intermittent, past studies provide a body of evidence that aquatic communities persist through time and are comparable to other communities found on Site and in other areas within the region (DOE 2003). While only one fish species is prevalent, the manipulated nature of the ponds and streams precludes the establishment of viable fish populations. However, macroinvertebrate populations appear to be less affected due to their ability to recolonize newly inundated habitats and their comparatively shorter life cycles. Macroinvertebrate communities in Walnut Creek are similar to those found in other RFETS streams. Additionally, recent sampling studies indicate macroinvertebrate communities found at RFETS are similar to other transitional foothills-plains and plains-type streams (DOE 2003). These findings support the conclusion that North Walnut Creek aquatic communities are healthy, albeit limited, and provide normal functions capable of sustaining rich and diverse aquatic life that comprise hardy and tolerant species adapted to the limiting environmental conditions.

REFERENCES

DOE, 1992, Baseline Biological Characterization of the Terrestrial and Aquatic Habitats at Rocky Flats Plant, Golden, Colorado.

DOE, 2003, Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, 2001-2002, Golden, Colorado.

K-H, 1998, Final Report: Lower Walnut Creek Aquatic Sampling, Spring 1998, Rocky Flats Environmental Technology Site, Golden, Colorado.

Wright Water Engineers, Inc., 2003, Supplemental Biological and Selected Water Quality Data Exploration 1997-2001, prepared for the Big Dry Creek Watershed Association Steering Committee, April.

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ATTACHMENT 2

TOXICITY THRESHOLDS
NORTH WALNUT CREEK AQUATIC EXPOSURE UNIT

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ACRONYMS AND ABBREVIATIONS

AETA	apparent effect threshold approach sediment quality value
AEU	Aquatic Exposure Unit
CB-PEC	consensus based - probable effects concentration
CDM	Criterion; Department of Ministry
COS	classification of sediment as slightly polluted
CRA	Comprehensive Risk Assessment
Crit	criterion, dry weight
CT	chronic toxicity
ECOPC	ecological contaminant of potential concern
EPA	U.S. Environmental Protection Agency
ERL	effect range low
ERM	effect range median
ESL	ecological screening level
ETV	ecotoxicological value, dry weight at 1% organic content
HQ	hazard quotient
LOAEL	lowest observed adverse effect level
µg/kg	micrograms per kilogram
MENVIQ/EC	Ministere de l'Environnement du Quebec
mg/kg	milligrams per kilogram
NIPHEP	National Institute of Public Health and Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
OMOE	Ontario Ministry of the Environment
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
PEC	probable effect concentration
PEL	probable effect level
SCV	secondary chronic value
SLCA	screening level concentration approach
SQA	sediment quality advisory level at 1% organic carbon guideline
SQC-MET	sediment quality criterion, minimal effect threshold, dry weight
SQC-TET	sediment quality criterion, toxic effect threshold, dry weight
SQG	sediment quality guideline
TEC	threshold effect concentration
TEL	threshold effect level
TNRCC	Texas Natural Resource Conservation Commission
WS-SQS	Washington State – Sediment Quality Standard

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TOXICITY THRESHOLDS

The toxicity analysis (or toxicity assessment) provides the toxicological benchmarks that are used to assess the relative risk of the exposure estimations. For Aquatic Exposure Units (AEUs), the toxicological benchmarks are presented as ecological contaminant of potential concern (ECOPC) concentrations in sediment. The benchmarks include the ecological screening levels (ESLs) identified in the Comprehensive Risk Assessment (CRA) Methodology (DOE 2004), as well as additional benchmarks taken from the toxicological literature and other regulatory programs. The benchmarks and their sources are described below.

Sediment ESLs and Toxicity Thresholds

A set of toxicity thresholds were selected for each ECOPC. The original sediment ESLs from the ECOPC identification process in the CRA Methodology were used in this assessment, along with toxicity thresholds obtained from the literature that represent a lowest observed adverse effect level (LOAEL) where available, or similar. The use of these two values for each ECOPC would then bracket the estimated risk using the hazard quotient (HQ) approach. A summary of the thresholds is provided in Table 1.

The endpoints for the sediment thresholds vary. In general, the median observed threshold from available studies was chosen. Compared to the ranges reported within Table 1, these values represent a central tendency measure. A description of the endpoints, as identified by the investigative study from where they were drawn, is provided below.

<u>MacDonald et al. 2000</u> - Numeric sediment quality guidelines (SQGs) were compiled and evaluated. A set of comparable SQGs were identified for certain inorganic and organic chemicals. For each chemical, two SQGs were identified:

- A threshold effect concentration (TEC); and
- A probable effect concentration (PEC).

The TECs were determined to provide a value in which there would be an absence of sediment toxicity, whereas the PECs are values that correlate to sediment toxicity. Based on results of their study, the incidence of sediment toxicity was generally low at contaminant concentrations below the TEC, while the PEC defined the concentration above which adverse effects are likely to occur. Because this study represents a culmination of numerous studies with combined endpoints for a suite of chemicals, the PEC was relied upon for the HQ evaluation.

<u>Ingersoll et al. 1996</u> - Sediment effect concentrations were developed for a suite of chemicals based upon laboratory data on the toxicity of contaminants associated with field-collected sediment to the amphipod *Hyalella azteca* and the midge *Chironomus riarius*. The sediment effect concentrations are defined as the concentrations of individual contaminants in sediment below which toxicity is rarely observed and above which toxicity is frequently observed. Three types of sediment effect concentrations were calculated from the data:

1. Effect range low (ERL) and effect range median (ERM);

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Table 1
Toxicity Thresholds for Sediment ECOPCs

ECOPC	Unit	Reported Range of Tox. Thresholds	Selected Toxicity Threshold[a]	Endpoint	Reference
Inorganics					
Aluminum	mg/kg	15900 – 58000	58000	ERM	Ingersoll et al. 1996
Antimony	mg/kg	2 – 500	3.2	SLCA	NYSDEC 1994
Arsenic	mg/kg	3 – 150	33	CB-PEC	MacDonald et al. 2000
Barium	mg/kg	20 – 500	287	SQG	TNRCC 1996
Cadmium	mg/kg	0.2 – 30	4.98	CB-PEC	MacDonald et al. 2000
Chromium	mg/kg	6.25 – 600	111	CB-PEC	MacDonald et al. 2000
Cobalt	mg/kg		50	CDM	OMOE 1987
Copper	mg/kg	8.4 – 840	149	CB-PEC	MacDonald et al. 2000
Fluoride	mg/kg	0.01 – 9.6	7	CT	Bolton et al. 1985
Iron	mg/kg	20000 – 290000	280000	ERM	Ingersoll et al. 1996
Lead	mg/kg	23 – 720	128	CB-PEC	MacDonald et al. 2000
Manganese	mg/kg	300 – 1800	1700	ERM	Ingersoll et al. 1996
Mercury	mg/kg	0.1 – 15	1.06	CB-PEC	MacDonald et al. 2000
Nickel	mg/kg	5 – 100	48.6	CB-PEC	MacDonald et al. 2000
Selenium	mg/kg	5 – 5	5	Crit	Nagpal et al. 1995
Silver	mg/kg	0.5 - 4.5	1.6	SQG	TNRCC 1996
Zinc	mg/kg	50 – 3200	459	CB-PEC	MacDonald et al. 2000
Organics					
1,2,4-Trimethylbenzene	ug/kg		9200	SQA	EPA 1997
Dichlorobenzene	ug/kg		340	SQA	EPA 1997
Trichlorophenol	ug/kg		340	SQA	EPA 1997
2-Butanone	ug/kg		270	SCV	EPA 1997
2-Methylnaphthalene	ug/kg	20 – 201	201	PEL	Environment Canada 1999
4-Methylphenol	ug/kg		670	WS-SQS	Ginn and Pastorak 1992
Acenaphthene	ug/kg	6.71 – 100000	1300	SQA	EPA 1997
Acenaphthylene	ug/kg	5.87 – 6000	1900	AETA	Cubbage et al. 1997
Aldrin	ug/kg	0.6 – 84	5.3	CT	Bolton et al. 1985
Ammonia	ug/kg	100 – 930	340	AETA	Cubbage et al. 1997
Anthracene	ug/kg	6.8 – 41000	845	CB-PEC	MacDonald et al. 2000
Aroclor-1016	ug/kg	7 – 530	100	SQC-MET	MENVIQ/EC. 1992
Aroclor-1242	ug/kg	100 – 100	100	AETA	Cubbage et al. 1997
Aroclor-1248	ug/kg	21 – 5100	50	SQC-MET	MENVIQ/EC. 1992
Aroclor-1254	ug/kg	7.3 – 604	60	SQC-TET	MacDonald et al. 2000
Aroclor-1260	ug/kg	5 – 240	5	SQC-TET	MacDonald et al. 2000
Atrazine	ug/kg		0.3	ETV	Stortelder et al. 1989
Benzo(a)anthracene	ug/kg		1050	CB-PEC	MacDonald et al. 2000
Benzo(a)pyrene	ug/kg	9.6 – 450000	470	CB-PEC	Ingersoll et al. 1996
Benzo(b,k)fluoranthene	ug/kg	27 – 37	37	ERM	Ingersoll et al. 1996
Benzo(g,h,i)perylene	ug/kg	10.4 – 21000	280	ERM	Ingersoll et al. 1996
Benzo(k)fluoranthene	ug/kg	2.6 – 1250000	750	COS	NIPHEP 1989
Benzofluoranthene	ug/kg	300 – 34000	2000	AETA	Cubbage et al. 1997
Benzyl Alcohol	ug/kg		57	SQA	Ginn and Pastorak 1992
Bis(2-ethylhexyl)phthalate	ug/kg	19.95 – 1197	640	AETA	Ingersoll et al. 1996

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ECOPC	Unit	Reported Range of Tox. Thresholds	Selected Toxicity Threshold[a]	Endpoint	Reference
Butylbenzylphthalate	ug/kg	11000 – 500000	11000	SQA	EPA, 1997
Carbazole	ug/kg	140 -1800	1600	AETA	Cubbage et al. 1997
Chlordane	ug/kg	0.3 – 60	17.60	CB-PEC	MacDonald et al. 2000
Chloroform	ug/kg	0.4 – 0.4	0.4	ETV	Stortelder et al. 1989
Chrysene	ug/kg	8.6 – 11500	1290	CB-PEC	MacDonald et al. 2000
DDD	ug/kg	4 – 60	28.00	CB-PEC	MacDonald et al. 2000
DDE	ug/kg	1 – 190	31.30	CB-PEC	MacDonald et al. 2000
DDT	ug/kg	6 – 11000	62.90	CB-PEC	MacDonald et al. 2000
Dibenz(a,h)anthracene	ug/kg	5 – 3500	230	AETA	Ingersoll et al. 1996
Dibenzofuran	ug/kg	2000 – 32000	24000	AETA	Ingersoll et al. 1996
Dichlorobenzene	ug/kg	32 – 1200	340	SQA	EPA 1997
Dichlorofluoromethane	ug/kg		52.56	SQA	EPA 1997
Dieldrin	ug/kg	0.1 – 910	61.80	CB-PEC	MacDonald et al. 2000
Di-n-butylphthalate	ug/kg		42	AETA	Ingersoll et al. 1996
Endrin	ug/kg		207.00	CB-PEC	MacDonald et al. 2000
Ethylbenzene	ug/kg	96 – 4800	4800	SQA	EPA 1997
Fluoranthene	ug/kg	20 – 130000	2230	CB-PEC	MacDonald et al. 2000
Fluorene	ug/kg		536	CB-PEC	MacDonald et al. 2000
Heptachlor epoxide	ug/kg		16.00	CB-PEC	MacDonald et al. 2000
Indeno(1,2,3-cd)pyrene	ug/kg	10.4 – 6000000	250	ERM	Ingersoll et al. 1996
Lindane	ug/kg		4.99	CB-PEC	MacDonald et al. 2000
Methylene chloride	ug/kg	500 – 500	500	CT	Bolton et al. 1985
Naphthalene	ug/kg	10 – 140000	561	CB-PEC	MacDonald et al. 2000
Phenanthrene	ug/kg	6.8 – 210000	1170	CB-PEC	MacDonald et al. 2000
Pyrene	ug/kg	7.6 – 85000	1520	CB-PEC	MacDonald et al. 2000
Tetrachloroethane	ug/kg	2.2 – 1600	1600	SQA	EPA 1997
Total DDTs	ug/kg		572.00	CB-PEC	MacDonald et al. 2000
Total PAHs	ug/kg	200 – 700000	22800.00	CB-PEC	MacDonald et al. 2000
Total PCBs	ug/kg	2.0 – 40000	676.00	CB-PEC	MacDonald et al. 2000

[a] The hierarch of use of the toxicity thresholds was as follows: MacDonald et al. 2000 as a preference; others (EPA 1997; Ingersoll et al. 1996; and so forth) have no preference compared to each other. The best available, most appropriate value is reported in these columns.

2. Threshold effect level (TEL) and probable effect level (PEL); and

3. No effect concentration.

For the purposes of this risk characterization, the available ERL or ERM values were used for the HQ evaluation. The ERL represents the chemical concentration below which adverse effects would rarely be observed. The ERL value represents the lower 10th percentile concentration associated with observations of biological effects. According to this method, concentrations below the ERL should rarely be associated with adverse effects (EPA 1996). The ERM represents the chemical concentration above which adverse effects would frequently occur. For the purposes of this evaluation, the reported ERL, if available, was selected as the toxicity threshold.

Texas Natural Resource Conservation Commission (TNRCC) 1996 - The value for barium was derived from this study and represents the SQG: 85th percentile level in reservoirs, dry weight. This value represents the average of the observed thresholds reviewed for this evaluation (reported range 20 to 500 milligrams per kilogram [mg/kg]).

REFERENCES

Bolton, H.S., R.J. Breteler, B.W. Vigon, J.A. Scanlon, and S.L. Clark, 1985, National Perspective on Sediment Quality Battelle. Prepared for EPA Contract No. 68-01-6986, Washington Environmental Program Office, Washington, D.C.

Cubbage, J., D. Batts, and S. Breidenbach, 1997, Creation and Analysis of Freshwater Sediment Quality Values in Washington State, Publication No. 97-323a, Washington State Department of Ecology, Olympia, Washington.

DOE, 2004, Comprehensive Risk Assessment Work Plan and Methodology, Rocky Flats Environmental Technology Site, Golden, Colorado, September.

Environment Canada, 1999, Canadian Water Quality Guidelines, Guidelines and Standards Division. Hull, Quebec, (document obtained from: http://www.ec.gs.ca/ceqg-rcqe/water.htm).

EPA, 1996, Ecotox Thresholds, ECO Update, Vol. 3, No. 2, Publ. 9345.0-12FS1, EPA 540/F-95/038.

EPA, 1997, The Incidence and Severity of Sediment Contamination in Surface Waters of the United States: Volume 1: National Sediment Quality Survey, USEPA 823-R-97-006, Office of Science and Technology, Washington, D.C.

Ginn, T.C. and R.A. Pastorak, 1992, Assessment and Management of Contaminated Sediments in Puget Sound. Pp. 371-401 in *Sediment Toxicity Assessment*, ed. G.A. Burton, Jr., Lewis Publishers, Boca Raton, Florida.

Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and T.G. Fos, 1996, "Calculation and evaluation of sediment effect concentrations for the amphipod Hyalella aztca and the midge *Chironomus riparius*." *Journal of Great Lakes Research* 22(3): 602-623.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000. "Development and Evaluation of Consensus-based Sediment Quality Guidelines for Fresh Water Ecosystems." Archives of Environmental Contamination, *Toxicology*. 39. 20-31

MENVIQ/EC, 1992, Interim Criteria for Quality Assessment of St. Lawrence River Sediment. ISBN 0-662-19849-2. St. Lawrence Action Plan. St. Lawrence Center and Ministere de l'Environnement du Quebec, Quebec City, Quebec.

Nagpal, N.K., L.W. Pommen, and L.G. Swain, 1995, Approved and working criteria for water quality. ISBN 0-7726-2522-0. Water Quality Branch. Ministry of Environment, Lands and Parks, Victoria, British Columbia.

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NIPHEP, 1989, Recommended Values for the Classification of Freshwater and Dredged Sediments, Bilthoven, Netherlands.

NYSDEC, 1994, Technical Guidance for Screening Contaminated Sediments, Division of Fish and Wildlife, Division of Marine Resources, Albany, New York.

OMOE, 1987, Guidelines for the Management of Dredged Material in Ontario, Toronto, Ontario.

Stortelder, P.B., M.A. van der Gaag, and L.A. van der Kooij, 1989, Perspectives for Water Organisms, An Ecotoxicological Basis for Quality Objectives for Water and Sediment, Part 1, Results and Calculations, DBW/RIZA Memorandum N. 89.01a (English Version August 1991), Institute for Inland Water Management and Waste Water Treatment, Lelystad, Netherlands.

TNRCC, 1996, The Surface Water Quality Monitoring Program Supplementary Information Manual, Statewide Percentile Report, Water Planning and Assessment Division, Austin, Texas.

ATTACHMENT 3

EVALUATION OF ADDITIONAL DATA – NORTH WALNUT CREEK AQUATIC EXPOSURE UNIT

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LIST OF TABLES

LIST OF FIGURES

ACRONYMS AND ABBREVIATIONS

AEU	Aquatic Exposure Unit
bkg	background
CRA	Comprehensive Risk Assessment
DL	detection limit
DOE	U.S. Department of Energy
ESL	ecological screening level
ft	foot
LOAEL	lowest observed adverse effects level
µg/kg	micrograms per kilogram
mg/kg	milligrams per kilogram
N/A	not applicable
ng/kg	nanogram per kilogram
NOAEL	no observed adverse effects level
NW AEU	North Walnut Creek Aquatic Exposure Unit
pCi/g	picocuries per gram
pg/g	picogram per gram
SAP	Sampling and Analysis Plan
SD	standard deviation
TEF	toxicity equivalent factor
TEQ	toxicity equivalent
VOC	volatile organic compound

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EVALUATION OF ADDITIONAL DATA

Additional data were collected from the drainage and pond areas to support Comprehensive Risk Assessment (CRA) evaluations in accordance with CRA Sampling and Analysis Plan (SAP) Addendum 05-01, Phase 2 - Targeted Sampling (DOE 2004). For the Upper Walnut area, two sediment sampling locations were identified, with several samples collected at each. These locations were from Ponds A-1 and A-2. These samples were analyzed for metals, radionuclides, dioxins, and volatile organic compounds (VOCs).

Results identified the presence of several constituents in each sample (shown on Figure 1-1). A discussion of the dioxin results and the evaluation of findings is presented, as well as a discussion for all other chemicals detected.

Evaluation of Dioxins

The observed concentrations from this new data set, compared to the range of observed results from all previously collected information (and presented in the accelerated action document) identified several dioxin congeners where the observed concentration was greater than the maximum of the comprehensive data set. These chemicals are summarized below, with a comparison to the maximum and the appropriate ecological screening level (ESL).

The observed dioxin concentrations were used to develop toxicity equivalent (TEQ) concentrations, using toxicity equivalent factors (TEFs) for each congener. The TEFs for each detected congener are provided in Table 3-1. The derived TEQ concentration by sample result is provided in Tables 3-2 and 3-3 for surface and subsurface sediment fractions, respectively. The summed totals are provided in Table 3-4. This information demonstrates two approaches for the total sum. The detected-congeners-only data consist of the sum totals from detected chemicals, while the all-congeners-analyzed data incorporate a conservative approach where one-half the detection limit is substituted and assumed for nondetected congeners in the calculation.

Results of these analyses were compared to available toxicity benchmarks protective of aquatic life. A value of 0.85 nanograms per kilogram (ng/kg or picogram per gram [pg/g]) no observed adverse effect level (NOAEL) and 21.5 ng/kg lowest observed adverse effect level (LOAEL) were used for the comparison (Van den Berg et al. 1998). The summed values provided in Table 3-4 are less than the LOAEL in all cases (by depth fraction) regardless of approach. The surface sediment concentration using the detected congener total is below the NOAEL and LOAEL. The summed totals calculated using the conservative approach using all congeners analyzed, exceed the NOAEL but still fall below the LOAEL. Because the surface fraction represents the most likely exposure medium to aquatic receptors, it appears risk is low because the observed concentrations are below the NOAEL.

Evaluation of Remaining Chemicals

Analyses also included metals, radionuclides, and VOCs. A summary of results is provided on Figure 1-1. The observed concentrations from this new data set, compared to the range of observed results from all previously collected information identified a few analytes where the observed concentration was greater than the maximum of the comprehensive data set. However, results obtained from the new data set were, in general, comparable to the range of results in the Nor Walnut Creek Aquatic Exposure Unit (EU) (AEU) (NW AEU) ecological screen. These chemicals are summarized in Table 3-5 with a comparison to the maximum and appropriate ESL.

Results from the new data set fall within the range of toxicity thresholds in Table 3-5. This indicates these measured values are within the range of toxicity values that correlate to no effect through lowest effect levels. These data will be incorporated into the CRA data sets and evaluated as part of the AEU risk assessment.

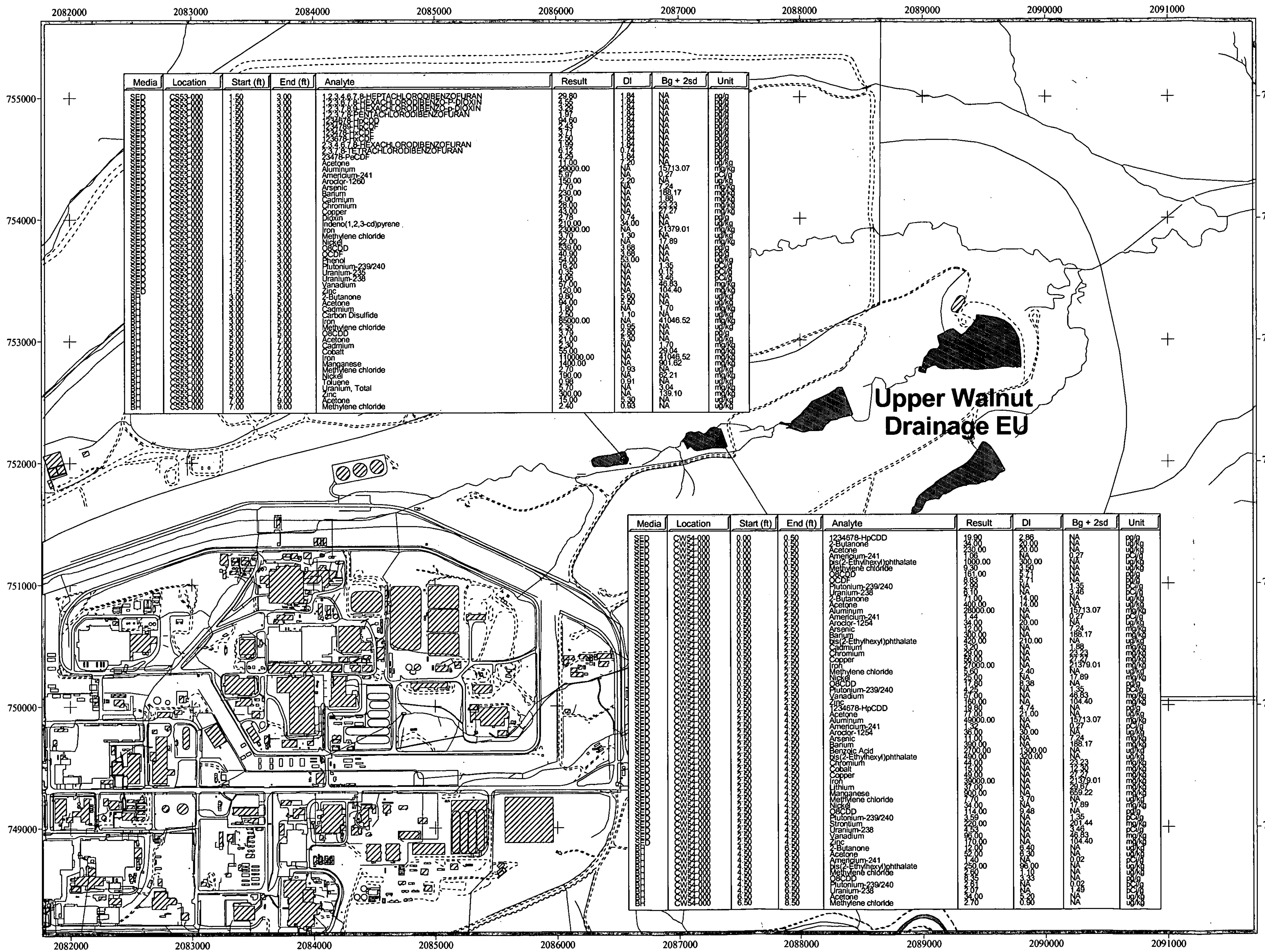
The results presented in the risk characterization would not be altered by additional data. The risk characterization addresses all of the chemicals identified above, with the exception of acetone. The detected acetone concentration in Pond A-2 was greater than the observed average from the accelerated action data set, and there are no available toxicity thresholds for this chemical.

REFERENCES

DOE, 2004, Final Comprehensive Risk Assessment Sampling and Analysis Plan Addendum 05-01, Phase 2- Targeted Sampling, Rocky Flats Environmental Technology Site, Golden, Colorado, December.

Van den Berg, M., L. Birnbaum, A.T.C. Bosveld, B. Brunstron, P. Cook, M. Feeley, J.P. Giesy, A. Hanberg, R. Hasegawa, S.W. Kennedy, T. Kubiak, J.C. Larsen, A.K. Djien Liem, C. Nolt, R.E. Peterson, L. Poellinger, S. Safe, D. Schrenk, D. Tillit, M. Tysklind, M. Younes, F. Waern, and T. Zacharewski, 1998, "Toxic Equivalency Factors (TEFs) for PCBs, PCDDs, PCDFs for Humans and Wildlife," Environ. Health Perspectives, Vol. 106, No. 12, 775-791.

Figure 3-1
Additional Sampling Results for the Upper Walnut Drainage EU



Media	Location	Start (ft)	End (ft)	Analyte	Result	Dl	Bg + 2sd	Unit
SED	CS53-000	1.50	3.00	1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN	29.80	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN	4.55	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	1,2,3,7,8,9-HEXACHLORODIBENZO-p-DIOXIN	3.29	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	1,2,3,7,8-PENTACHLORODIBENZOFURAN	1.97	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	1234678-HpCDD	94.60	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	1234789-HpCDF	2.43	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	123478-HxCDF	3.71	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	123678-HxCDF	2.50	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	2,3,4,6,7,8-HEXACHLORODIBENZOFURAN	1.99	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	2,3,7,8-TETRACHLORODIBENZOFURAN	6.12	0.74	NA	pg/g
SED	CS53-000	1.50	3.00	23478-PeCDF	4.29	1.84	NA	pg/g
SED	CS53-000	1.50	3.00	Acetone	11.00	7.20	NA	ug/kg
SED	CS53-000	1.50	3.00	Aluminum	29000.00	NA	15713.07	mg/kg
SED	CS53-000	1.50	3.00	Americium-241	5.97	NA	0.27	pCi/g
SED	CS53-000	1.50	3.00	Aroclor-1260	150.00	2.20	NA	ug/kg
SED	CS53-000	1.50	3.00	Arsenic	7.70	NA	7.24	mg/kg
SED	CS53-000	1.50	3.00	Barium	230.00	NA	188.17	mg/kg
SED	CS53-000	1.50	3.00	Cadmium	2.00	NA	1.88	mg/kg
SED	CS53-000	1.50	3.00	Chromium	28.00	NA	23.23	mg/kg
SED	CS53-000	1.50	3.00	Copper	43.00	NA	27.27	mg/kg
SED	CS53-000	1.50	3.00	Dioxin	2.78	0.74	NA	pg/g
SED	CS53-000	1.50	3.00	Indeno(1,2,3-cd)pyrene	210.00	34.00	NA	ug/kg
SED	CS53-000	1.50	3.00	Iron	23000.00	NA	21379.01	mg/kg
SED	CS53-000	1.50	3.00	Methylene chloride	3.70	1.30	NA	ug/kg
SED	CS53-000	1.50	3.00	Nickel	22.00	NA	17.89	mg/kg
SED	CS53-000	1.50	3.00	O8CDD	539.00	3.68	NA	pg/g
SED	CS53-000	1.50	3.00	OCDF	40.90	3.68	NA	pg/g
SED	CS53-000	1.50	3.00	Phenol	54.00	53.00	NA	ug/kg
SED	CS53-000	1.50	3.00	Plutonium-239/240	16.20	NA	1.35	pCi/g
SED	CS53-000	1.50	3.00	Uranium-235	0.35	NA	0.15	pCi/g
SED	CS53-000	1.50	3.00	Uranium-238	4.06	NA	3.46	pCi/g
SED	CS53-000	1.50	3.00	Vanadium	57.00	NA	46.83	mg/kg
SED	CS53-000	1.50	3.00	Zinc	120.00	NA	104.40	mg/kg
BH	CS53-000	3.00	5.00	2-Butanone	9.80	5.60	NA	ug/kg
BH	CS53-000	3.00	5.00	Acetone	94.00	5.50	NA	ug/kg
BH	CS53-000	3.00	5.00	Cadmium	1.80	NA	1.70	mg/kg
BH	CS53-000	3.00	5.00	Carbon Disulfide	2.50	1.10	NA	ug/kg
BH	CS53-000	3.00	5.00	Iron	85000.00	NA	41046.52	mg/kg
BH	CS53-000	3.00	5.00	Methylene chloride	2.30	0.95	NA	ug/kg
BH	CS53-000	3.00	5.00	O8CDD	3.79	2.80	NA	pg/g
BH	CS53-000	5.00	7.00	Acetone	21.00	5.30	NA	ug/kg
BH	CS53-000	5.00	7.00	Cadmium	2.30	NA	1.70	mg/kg
BH	CS53-000	5.00	7.00	Cobalt	55.00	NA	29.04	mg/kg
BH	CS53-000	5.00	7.00	Iron	110000.00	NA	41046.52	mg/kg
BH	CS53-000	5.00	7.00	Manganese	1400.00	NA	901.62	mg/kg
BH	CS53-000	5.00	7.00	Methylene chloride	2.70	0.93	NA	ug/kg
BH	CS53-000	5.00	7.00	Nickel	190.00	NA	62.21	mg/kg
BH	CS53-000	5.00	7.00	Toluene	0.98	0.91	NA	ug/kg
BH	CS53-000	5.00	7.00	Uranium, Total	5.70	NA	3.04	mg/kg
BH	CS53-000	5.00	7.00	Zinc	300.00	NA	139.10	mg/kg
BH	CS53-000	7.00	9.00	Acetone	15.00	5.30	NA	ug/kg
BH	CS53-000	7.00	9.00	Methylene chloride	2.40	0.93	NA	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Dl	Bg + 2sd	Unit
SED	CW54-000	0.00	0.50	1234678-HpCDD	19.90	2.86	NA	pg/g
SED	CW54-000	0.00	0.50	2-Butanone	34.00	20.00	NA	ug/kg
SED	CW54-000	0.00	0.50	Acetone	230.00	20.00	NA	ug/kg
SED	CW54-000	0.00	0.50	Americium-241	1.06	NA	0.27	pCi/g
SED	CW54-000	0.00	0.50	bis(2-Ethylhexyl)phthalate	1000.00	300.00	NA	ug/kg
SED	CW54-000	0.00	0.50	Methylene chloride	9.30	3.50	NA	ug/kg
SED	CW54-000	0.00	0.50	O8CDD	161.00	5.71	NA	pg/g
SED	CW54-000	0.00	0.50	OCDF	8.83	5.71	NA	pg/g
SED	CW54-000	0.00	0.50	Plutonium-239/240	2.99	NA	1.35	pCi/g
SED	CW54-000	0.00	0.50	Uranium-238	6.10	NA	3.46	pCi/g
SED	CW54-000	0.50	2.50	2-Butanone	71.00	14.00	NA	ug/kg
SED	CW54-000	0.50	2.50	Acetone	400.00	14.00	NA	ug/kg
SED	CW54-000	0.50	2.50	Aluminum	28000.00	NA	15713.07	mg/kg
SED	CW54-000	0.50	2.50	Americium-241	1.44	NA	0.27	pCi/g
SED	CW54-000	0.50	2.50	Aroclor-1254	34.00	20.00	NA	ug/kg
SED	CW54-000	0.50	2.50	Arsenic	12.00	NA	7.24	mg/kg
SED	CW54-000	0.50	2.50	Barium	300.00	NA	188.17	mg/kg
SED	CW54-000	0.50	2.50	bis(2-Ethylhexyl)phthalate	420.00	210.00	NA	ug/kg
SED	CW54-000	0.50	2.50	Cadmium	3.20	NA	1.88	mg/kg
SED	CW54-000	0.50	2.50	Chromium	29.00	NA	23.23	mg/kg
SED	CW54-000	0.50	2.50	Copper	56.00	NA	27.27	mg/kg
SED	CW54-000	0.50	2.50	Iron	27000.00	NA	21379.01	mg/kg
SED	CW54-000	0.50	2.50	Methylene chloride	5.60	2.40	NA	ug/kg
SED	CW54-000	0.50	2.50	Nickel	25.00	NA	17.89	mg/kg
SED	CW54-000	0.50	2.50	O8CDD	17.80	8.38	NA	pg/g
SED	CW54-000	0.50	2.50	Plutonium-239/240	4.25	NA	1.35	pCi/g
SED	CW54-000	0.50	2.50	Vanadium	57.00	NA	46.83	mg/kg
SED	CW54-000	0.50	2.50	Zinc	160.00	NA	104.40	mg/kg
SED	CW54-000	2.50	4.50	1234678-HpCDD	19.80	4.74	NA	pg/g
SED	CW54-000	2.50	4.50	Acetone	77.00	21.00	NA	ug/kg
SED	CW54-000	2.50	4.50	Aluminum	49000.00	NA	15713.07	mg/kg
SED	CW54-000	2.50	4.50	Americium-241	1.32	NA	0.27	pCi/g
SED	CW54-000	2.50	4.50	Aroclor-1254	36.00	30.00	NA	ug/kg
SED	CW54-000	2.50	4.50	Arsenic	11.00	NA	7.24	mg/kg
SED	CW54-000	2.50	4.50	Barium	390.00	NA	188.17	mg/kg
SED	CW54-000	2.50	4.50	Benzoic Acid	2700.00	1300.00	NA	ug/kg
SED	CW54-000	2.50	4.50	bis(2-Ethylhexyl)phthalate	490.00	320.00	NA	ug/kg
SED	CW54-000	2.50	4.50	Chromium	44.00	NA	23.23	mg/kg
SED	CW54-000	2.50	4.50	Cobalt	15.00	NA	12.30	mg/kg
SED	CW54-000	2.50	4.50	Copper	49.00	NA	27.27	mg/kg
SED	CW54-000	2.50	4.50	Iron	39000.00	NA	21379.01	mg/kg
SED	CW54-000	2.50	4.50	Lithium	37.00	NA	29.67	mg/kg
SED	CW54-000	2.50	4.50	Manganese	900.00	NA	659.22	mg/kg
SED	CW54-000	2.50	4.50	Methylene chloride	7.70	3.70	NA	ug/kg
SED	CW54-000	2.50	4.50	Nickel	34.00	NA	17.89	mg/kg
SED	CW54-000	2.50	4.50	O8CDD	114.00	9.48	NA	pg/g
SED	CW54-000	2.50	4.50	Plutonium-239/240	3.59	NA	1.35	pCi/g
SED	CW54-000	2.50	4.50	Strontium	220.00	NA	201.44	mg/kg
SED	CW54-000	2.50	4.50	Uranium-238	4.53	NA	3.46	pCi/g
SED	CW54-000	2.50	4.50	Vanadium	96.00	NA	46.83	mg/kg
SED	CW54-000	2.50	4.50	Zinc	170.00	NA	104.40	mg/kg
BH	CW54-000	4.50	6.50	2-Butanone	12.00	6.40	NA	ug/kg
BH	CW54-000	4.50	6.50	Acetone	52.00	6.30	NA	ug/kg
BH	CW54-000	4.50	6.50	Americium-241	1.40	NA	0.02	pCi/g
BH	CW54-000	4.50	6.50	bis(2-Ethylhexyl)phthalate	250.00	96.00	NA	ug/kg
BH	CW54-000	4.50	6.50	Methylene chloride	2.60	1.10	NA	ug/kg
BH	CW54-000	4.50	6.50	O8CDD	8.35	3.33	NA	pg/g
BH	CW54-000	4.50	6.50	Plutonium-239/240	2.61	NA	0.02	pCi/g
BH	CW54-000	4.50	6.50	Uranium-238	2.07	NA	1.49	pCi/g
BH	CW54-000	6.50	8.50	Acetone	34.00	5.20	NA	ug/kg
BH	CW54-000	6.50	8.50	Methylene chloride	2.70	0.90	NA	ug/kg

Legend

- Detect > Bkg Mean Plus 2 SD or DL
- Exposure Unit
- Stream
- Pond
- Paved road
- Unpaved road

Structures

- Demolished
- Standing
- Site boundary

DRAFT

N S E W

500 0 500 Feet

Scale = 1 : 10,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Date: February 21, 2005

RADMS

Prepared for:

KAISER•HILL COMPANY

File: W:\Projects\Fy2004\CF Targeted Sampling\sed_sw_samples.apr

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Table 3-1
North Walnut Creek Aquatic Exposure Unit TEFs

Dioxin Congener	Aquatic TEF
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN (HpCDF)	0.01
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN (HpCDD)	0.01
1,2,3,7,8,9-HEXACHLORODIBENZO-p-DIOXIN (HxCDD)	0.01
1,2,3,7,8-PENTACHLORODIBENZOFURAN (PeCDF)	0.05
1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN (PeCDD)	1
1,2,3,4,6,7,8-HpCDD	0.001
1,2,3,4,7,8,9-HpCDF	0.01
1,2,3,4,7,8-HxCDD	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN (HxCDF)	0.1
2,3,7,8-TETRACHLORODIBENZOFURAN (TCDF)	0.05
2,3,4,7,8-PeCDF	0.5
Dioxin	1
OCDD	0.0001
OCDF	0.0001

Source: Van den Berg et al. 1998

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Table 3-2
North Walnut Creek Aquatic Exposure Unit Surface Sediment Toxicity Equivalent Concentrations by Congener

Sample Number	Congener	Start Depth (ft)	End Depth (ft)	Result (pg/g)	Detected?	Derived Result[a] (pg/g)	Aquatic TEF (pg/g)	Aquatic TEQ (pg/g)
CW54-000	1,2,3,4,6,7,8-HpCDF	0	0.5	2.51	Yes	2.51	0.01	0.0251
CW54-000	1,2,3,6,7,8-HpCDD	0	0.5	1.22	Yes	1.22	0.01	0.0122
CW54-000	1,2,3,7,8,9-HpCDD	0	0.5	1.06	Yes	1.06	0.01	0.0106
CW54-000	1,2,3,7,8-PeCDD	0	0.5	2.86	No	1.43	1	1.43
CW54-000	1,2,3,7,8-PeCDF	0	0.5	2.86	No	1.43	0.05	0.0715
CW54-000	1,2,3,4,6,7,8-HpCDD	0	0.5	19.9	Yes	19.9	0.001	0.0199
CW54-000	1,2,3,4,7,8-HxCDD	0	0.5	2.86	No	1.43	0.5	0.715
CW54-000	1,2,3,4,7,8-HxCDF	0	0.5	0.566	Yes	0.566	0.1	0.0566
CW54-000	1,2,3,4,7,8,9-HpCDF	0	0.5	2.86	No	1.43	0.01	0.0143
CW54-000	1,2,3,6,7,8-HxCDF	0	0.5	2.86	No	1.43	0.1	0.143
CW54-000	1,2,3,7,8,9-HxCDF	0	0.5	2.86	No	1.43	0.1	0.143
CW54-000	2,3,4,6,7,8-PeCDD	0	0.5	2.86	No	1.43	0.1	0.143
CW54-000	2,3,7,8-HxCDF	0	0.5	1.14	No	0.57	0.05	0.0285
CW54-000	2,3,4,7,8-PeCDF	0	0.5	2.86	No	1.43	0.5	0.715
CW54-000	Dioxin	0	0.5	1.14	No	0.57	1	0.57
CW54-000	O8CDD	0	0.5	161	Yes	161	0.0001	0.0161
CW54-000	OCDF	0	0.5	8.83	Yes	8.83	0.0001	0.000883

[a] Reported result or one-half the reported result for nondetects

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Table 3-3
North Walnut Creek Aquatic Exposure Unit
Subsurface Sediment Toxicity Equivalent Concentrations by Congener

Sample Number	Congener	Start Depth (ft)	End Depth (ft)	Result (pg/g)	Detect	Derived Result[a] (pg/g)	Aquatic TEF (pg/g)	Aquatic TEQ (pg/g)
CS53-000	1,2,3,4,6,7,8-HpCDF	1.5	3	29.8	Yes	29.8	0.01	0.298
CS53-000	1,2,3,6,7,8-HpCDD	1.5	3	4.55	Yes	4.55	0.01	0.0455
CS53-000	1,2,3,7,8,9-HxCDD	1.5	3	3.29	Yes	3.29	0.01	0.0329
CS53-000	1,2,3,7,8-PeCDF	1.5	3	1.97	Yes	1.97	0.05	0.0985
CS53-000	1,2,3,7,8-PeCDD	1.5	3	1.84	No	0.92	1	0.92
CS53-000	1,2,3,4,6,7,8-HpCDD	1.5	3	94.6	Yes	94.6	0.001	0.0946
CS53-000	1,2,3,4,7,8,9-HpCDF	1.5	3	2.43	Yes	2.43	0.01	0.0243
CS53-000	1,2,3,4,7,8-HxCDD	1.5	3	1.26	Yes	1.26	0.5	0.63
CS53-000	1,2,3,4,7,8-HxCDF	1.5	3	3.71	Yes	3.71	0.1	0.371
CS53-000	1,2,3,6,7,8-HxCDF	1.5	3	2.5	Yes	2.5	0.1	0.25
CS53-000	1,2,3,7,8,9-HxCDF	1.5	3	1.84	No	0.92	0.1	0.092
CS53-000	2,3,4,6,7,8-HxCDF	1.5	3	1.99	Yes	1.99	0.1	0.199
CS53-000	2,3,7,8-TCDF	1.5	3	6.12	Yes	6.12	0.05	0.306
CS53-000	2,3,4,7,8-PeCDF	1.5	3	4.29	Yes	4.29	0.5	2.145
CS53-000	Dioxin	1.5	3	2.78	Yes	2.78	1	2.78
CS53-000	O8CDD	1.5	3	539	Yes	539	0.0001	0.0539
CS53-000	OCDF	1.5	3	40.9	Yes	40.9	0.0001	0.00409
CS53-000	1,2,3,4,6,7,8-HpCDF	3	5	0.501	Yes	0.501	0.01	0.00501
CS53-000	1,2,3,6,7,8-HpCDD	3	5	1.4	No	0.7	0.01	0.007
CS53-000	1,2,3,7,8,9-HxCDD	3	5	1.4	No	0.7	0.01	0.007
CS53-000	1,2,3,7,8-PeCDD	3	5	1.4	No	0.7	0.05	0.035
CS53-000	1,2,3,7,8-PeCDD	3	5	1.4	No	0.7	1	0.7
CS53-000	1,2,3,4,6,7,8-HpCDD	3	5	0.708	Yes	0.708	0.001	0.000708
CS53-000	1,2,3,4,7,8,9-HpCDF	3	5	0.182	Yes	0.182	0.01	0.00182
CS53-000	1,2,3,4,7,8-HxCDD	3	5	1.4	No	0.7	0.5	0.35
CS53-000	1,2,3,4,7,8-HxCDF	3	5	0.256	Yes	0.256	0.1	0.0256
CS53-000	1,2,3,6,7,8-HxCDF	3	5	1.4	No	0.7	0.1	0.07
CS53-000	1,2,3,7,8,9-HxCDF	3	5	1.4	No	0.7	0.1	0.07
CS53-000	2,3,4,6,7,8-HxCDF	3	5	1.4	No	0.7	0.1	0.07
CS53-000	2,3,7,8-PeCDF	3	5	0.559	No	0.2795	0.05	0.013975
CS53-000	2,3,4,7,8-PeCDF	3	5	1.4	No	0.7	0.5	0.35
CS53-000	Dioxin	3	5	0.226	Yes	0.226	1	0.226
CS53-000	O8CDD	3	5	3.79	Yes	3.79	0.0001	0.000379
CS53-000	OCDF	3	5	0.65	Yes	0.65	0.0001	0.000065
CS53-000	1,2,3,4,6,7,8-HpCDF	5	7	1.38	No	0.69	0.01	0.0069
CS53-000	1,2,3,6,7,8-HpCDD	5	7	1.38	No	0.69	0.01	0.0069
CS53-000	1,2,3,7,8,9-HxCDD	5	7	1.38	No	0.69	0.01	0.0069
CS53-000	1,2,3,7,8-PeCDF	5	7	1.38	No	0.69	0.05	0.0345
CS53-000	1,2,3,7,8-PeCDD	5	7	1.38	No	0.69	1	0.69
CS53-000	1,2,3,4,6,7,8-HpCDD	5	7	1.38	No	0.69	0.001	0.00069
CS53-000	1,2,3,4,7,8,9-HpCDF	5	7	1.38	No	0.69	0.01	0.0069
CS53-000	1,2,3,4,7,8-HxCDD	5	7	1.38	No	0.69	0.5	0.345

Sample Number	Congener	Start Depth (ft)	End Depth (ft)	Result (pg/g)	Detect	Derived Result[a] (pg/g)	Aquatic TEF (pg/g)	Aquatic TEQ (pg/g)
CS53-000	123478-HxCDF	5	7	1.38	No	0.69	0.1	0.069
CS53-000	123678-HxCDF	5	7	1.38	No	0.69	0.1	0.069
CS53-000	123789-HxCDF	5	7	1.38	No	0.69	0.1	0.069
CS53-000	2,3,4,6,7,8-PeCDD	5	7	1.38	No	0.69	0.1	0.069
CS53-000	2,3,7,8-TCDF	5	7	0.552	No	0.276	0.05	0.0138
CS53-000	2,3,4,7,8-PeCDF	5	7	1.38	No	0.69	0.5	0.345
CS53-000	Dioxin	5	7	0.552	No	0.276	1	0.276
CS53-000	O8CDD	5	7	2.76	No	1.38	0.0001	0.000138
CS53-000	OCDF	5	7	2.76	No	1.38	0.0001	0.000138
CS53-000	1,2,3,4,6,7,8-HpCDF	7	9	1.35	No	0.675	0.01	0.00675
CS53-000	1,2,3,6,7,8-HpCDD	7	9	1.35	No	0.675	0.01	0.00675
CS53-000	1,2,3,7,8,9-HxCDD	7	9	1.35	No	0.675	0.01	0.00675
CS53-000	1,2,3,7,8-PeCDF	7	9	1.35	No	0.675	0.05	0.03375
CS53-000	1,2,3,7,8-PeCDD	7	9	1.35	No	0.675	1	0.675
CS53-000	1,2,3,4,6,7,8-HpCDD	7	9	1.35	No	0.675	0.001	0.000675
CS53-000	1,2,3,4,7,8,9-HpCDF	7	9	1.35	No	0.675	0.01	0.00675
CS53-000	1,2,3,4,7,8-HxCDD	7	9	1.35	No	0.675	0.5	0.3375
CS53-000	1,2,3,4,7,8-HxCDF	7	9	1.35	No	0.675	0.1	0.0675
CS53-000	1,2,3,6,7,8-HxCDF	7	9	1.35	No	0.675	0.1	0.0675
CS53-000	1,2,3,7,8,9-HxCDF	7	9	1.35	No	0.675	0.1	0.0675
CS53-000	2,3,4,6,7,8-HxCDF	7	9	1.35	No	0.675	0.1	0.0675
CS53-000	2,3,7,8-TCDF	7	9	0.54	No	0.27	0.05	0.0135
CS53-000	2,3,4,7,8-PeCDF	7	9	1.35	No	0.675	0.5	0.3375
CS53-000	Dioxin	7	9	0.54	No	0.27	1	0.27
CS53-000	O8CDD	7	9	0.518	Yes	0.518	0.0001	0.0000518
CS53-000	OCDF	7	9	2.7	No	1.35	0.0001	0.000135
CW54-000	1,2,3,4,6,7,8-HpCDF	0.5	2.5	4.19	No	2.095	0.01	0.02095
CW54-000	1,2,3,6,7,8-HpCDD	0.5	2.5	4.19	No	2.095	0.01	0.02095
CW54-000	1,2,3,7,8,9-HxCDD	0.5	2.5	4.19	No	2.095	0.01	0.02095
CW54-000	1,2,3,7,8-PeCDF	0.5	2.5	4.19	No	2.095	0.05	0.10475
CW54-000	1,2,3,7,8-PeCDD	0.5	2.5	4.19	No	2.095	1	2.095
CW54-000	1,2,3,4,6,7,8-HpCDD	0.5	2.5	4.19	No	2.095	0.001	0.002095
CW54-000	1,2,3,4,7,8,9-HpCDF	0.5	2.5	0.74	Yes	0.74	0.01	0.0074
CW54-000	1,2,3,4,7,8-HxCDD	0.5	2.5	4.19	No	2.095	0.5	1.0475
CW54-000	1,2,3,4,7,8-HxCDF	0.5	2.5	4.19	No	2.095	0.1	0.2095
CW54-000	1,2,3,6,7,8-HxCDF	0.5	2.5	4.19	No	2.095	0.1	0.2095
CW54-000	1,2,3,7,8,9-HxCDF	0.5	2.5	0.553	Yes	0.553	0.1	0.0553
CW54-000	2,3,4,6,7,8-HxCDF	0.5	2.5	4.19	No	2.095	0.1	0.2095
CW54-000	2,3,7,8-TCDF	0.5	2.5	1.68	No	0.84	0.05	0.042
CW54-000	2,3,4,7,8-PeCDF	0.5	2.5	4.19	No	2.095	0.5	1.0475
CW54-000	Dioxin	0.5	2.5	1.68	No	0.84	1	0.84
CW54-000	O8CDD	0.5	2.5	17.8	Yes	17.8	0.0001	0.00178
CW54-000	OCDF	0.5	2.5	8.38	No	4.19	0.0001	0.000419
CW54-000	1,2,3,4,6,7,8-HpCDF	2.5	4.5	2.83	Yes	2.83	0.01	0.0283
CW54-000	1,2,3,6,7,8-HpCDD	2.5	4.5	4.74	No	2.37	0.01	0.0237
CW54-000	1,2,3,7,8,9-HxCDD	2.5	4.5	4.74	No	2.37	0.01	0.0237

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Sample Number	Congener	Start Depth (ft)	End Depth (ft)	Result (pg/g)	Detect	Derived Result[a] (pg/g)	Aquatic TEF (pg/g)	Aquatic TEQ (pg/g)
CW54-000	1,2,3,7,8-PeCDF	2.5	4.5	4.74	No	2.37	0.05	0.1185
CW54-000	1,2,3,7,8-PeCDD	2.5	4.5	4.74	No	2.37	1	2.37
CW54-000	1,2,3,4,6,7,8-HpCDD	2.5	4.5	19.8	Yes	19.8	0.001	0.0198
CW54-000	1,2,3,4,7,8,9-HpCDF	2.5	4.5	0.77	Yes	0.77	0.01	0.0077
CW54-000	1,2,3,4,7,8-HxCDD	2.5	4.5	4.74	No	2.37	0.5	1.185
CW54-000	1,2,3,4,7,8-HxCDF	2.5	4.5	0.55	Yes	0.55	0.1	0.055
CW54-000	1,2,3,6,7,8-HxCDF	2.5	4.5	4.74	No	2.37	0.1	0.237
CW54-000	1,2,3,7,8,9-HxCDF	2.5	4.5	4.74	No	2.37	0.1	0.237
CW54-000	2,3,4,6,7,8-HxCDF	2.5	4.5	4.74	No	2.37	0.1	0.237
CW54-000	2,3,7,8-TCDF	2.5	4.5	1.9	No	0.95	0.05	0.0475
CW54-000	2,3,4,7,8-PeCDF	2.5	4.5	4.74	No	2.37	0.5	1.185
CW54-000	Dioxin	2.5	4.5	1.9	No	0.95	1	0.95
CW54-000	O8CDD	2.5	4.5	114	Yes	114	0.0001	0.0114
CW54-000	OCDF	2.5	4.5	5.83	Yes	5.83	0.0001	0.000583
CW54-000	1,2,3,4,6,7,8-HpCDF	4.5	6.5	1.66	No	0.83	0.01	0.0083
CW54-000	1,2,3,6,7,8-HpCDD	4.5	6.5	1.66	No	0.83	0.01	0.0083
CW54-000	1,2,3,7,8,9-HxCDD	4.5	6.5	1.66	No	0.83	0.01	0.0083
CW54-000	1,2,3,7,8-PeCDF	4.5	6.5	1.66	No	0.83	0.05	0.0415
CW54-000	1,2,3,7,8-PeCDD	4.5	6.5	1.66	No	0.83	1	0.83
CW54-000	1,2,3,4,6,7,8-HpCDD	4.5	6.5	1.56	Yes	1.56	0.001	0.00156
CW54-000	1,2,3,4,7,8,9-HpCDF	4.5	6.5	0.34	Yes	0.34	0.01	0.0034
CW54-000	1,2,3,4,7,8-HxCDD	4.5	6.5	1.66	No	0.83	0.5	0.415
CW54-000	1,2,3,4,7,8-HxCDF	4.5	6.5	1.66	No	0.83	0.1	0.083
CW54-000	1,2,3,6,7,8-HxCDF	4.5	6.5	1.66	No	0.83	0.1	0.083
CW54-000	1,2,3,7,8,9-HxCDF	4.5	6.5	1.66	No	0.83	0.1	0.083
CW54-000	2,3,4,6,7,8-HxCDF	4.5	6.5	1.66	No	0.83	0.1	0.083
CW54-000	2,3,7,8-TCDF	4.5	6.5	0.666	No	0.333	0.05	0.01665
CW54-000	2,3,4,7,8-PeCDF	4.5	6.5	1.66	No	0.83	0.5	0.415
CW54-000D	Dioxin	4.5	6.5	0.666	No	0.333	1	0.333
CW54-000	O8CDD	4.5	6.5	8.35	Yes	8.35	0.0001	0.000835
CW54-000	OCDF	4.5	6.5	3.33	No	1.665	0.0001	0.0001665
CW54-000	1,2,3,4,6,7,8-HpCDF	6.5	8.5	0.139	Yes	0.139	0.01	0.00139
CW54-000	1,2,3,6,7,8-HpCDD	6.5	8.5	1.38	No	0.69	0.01	0.0069
CW54-000	1,2,3,7,8,9-HxCDD	6.5	8.5	1.38	No	0.69	0.01	0.0069
CW54-000	1,2,3,7,8-PeCDF	6.5	8.5	1.38	No	0.69	0.05	0.0345
CW54-000	1,2,3,7,8-PeCDD	6.5	8.5	1.38	No	0.69	1	0.69
CW54-000	1,2,3,4,6,7,8-HpCDD	6.5	8.5	1.38	No	0.69	0.001	0.00069
CW54-000	1,2,3,4,7,8,9-HpCDF	6.5	8.5	1.38	No	0.69	0.01	0.0069
CW54-000	1,2,3,4,7,8-HxCDD	6.5	8.5	1.38	No	0.69	0.5	0.345
CW54-000	1,2,3,4,7,8-HxCDF	6.5	8.5	1.38	No	0.69	0.1	0.069
CW54-000	1,2,3,6,7,8-HxCDF	6.5	8.5	1.38	No	0.69	0.1	0.069
CW54-000	1,2,3,7,8,9-HxCDF	6.5	8.5	1.38	No	0.69	0.1	0.069
CW54-000	2,3,4,6,7,8-PeCDF	6.5	8.5	1.38	No	0.69	0.1	0.069
CW54-000	2,3,7,8-TCDF	6.5	8.5	0.55	No	0.275	0.05	0.01375
CW54-000	2,3,4,7,8-PeCDF	6.5	8.5	1.38	No	0.69	0.5	0.345
CW54-000	Dioxin	6.5	8.5	0.55	No	0.275	1	0.275

Sample Number	Congener	Start Depth (ft)	End Depth (ft)	Result (pg/g)	Detect	Derived Result[a] (pg/g)	Aquatic TEF (pg/g)	Aquatic TEQ (pg/g)
CW54-000	O8CDD	6.5	8.5	2.75	No	1.375	0.0001	0.0001375
CW54-000	OCDF	6.5	8.5	2.75	No	1.375	0.0001	0.0001375

[a] Reported result or one-half the reported result for nondetects

Table 3-4
North Walnut Creek Summed Total Toxicity Equivalent Concentrations by Depth Fraction

Sample Number	Start Depth (ft)	End Depth (ft)	Detected Congeners Only	All Congeners Analyzed[a]
Surface Sediments (pg/g)				
CW54-000A	0	0.5	0.14	4.11
Subsurface Sediments (pg/g)				
CS53-000B	1.5	3	7.33	8.34
CS53-000C	3	5	0.26	1.93
CS53-000D	5	7	Not Detected	2.01
CS53-000E	7	9	0.00005	1.97
CW54-000B	0.5	2.5	0.06	5.94
CW54-000C	2.5	4.5	0.12	6.74
CW54-000D	4.5	6.5	0.006	2.41
CW54-000E	6.5	8.5	0.001	2.00

[a] One-half the reported result was used in the TEQ calculation for nondetected congeners.

Table 3-5
Summary of Results for Metals, Radionuclides, and VOCs

Chemical	New Results by Pond		Maximum – Accelerated Action Reported Value	Toxicity Thresholds
	Pond A-1	Pond A-2		
Inorganics mg/kg				
Aluminum	29000	28000	27400	15900-58000
Barium	230	300	219	189-287
Radionuclides (pCi/g)				
Uranium-235	0.35		0.2	3730
Uranium-238	4.06	6.10	5.9	2490
Organics (ug/kg)				
2-Butanone		71	43	NA
Acetone	11	400	260	NA
Methylene chloride	3.7	9.3	7	NA
Phenol	54		22	773

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APPENDIX B

ECOLOGICAL SCREENING SUMMARY
FOR THE SOUTH WALNUT CREEK AQUATIC EXPOSURE UNIT

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ACRONYMS AND ABBREVIATIONS

AEU	Aquatic Exposure Unit
BKG	background
BZ	Buffer Zone
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
DSR	Data Summary Report
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EEC	Extreme effects concentration
EPC	exposure point concentration
ERA	Ecological Risk Assessment
ESL	ecological screening level
EU	Exposure Unit
HQ	hazard quotient
IA	Industrial Area
IABZSAP	Industrial Area and Buffer Zone Sampling and Analysis Plan
IHSS	Individual Hazardous Substance Site
LOAEL	lowest observed adverse effect level
µg/kg	micrograms per kilogram (may be found as ug/kg)
MDC	maximum detected concentration
MEC	mid-range effect concentration
mg/kg	milligrams per kilogram
N/A	not applicable
NOAEL	no observed adverse effect level
OU	Operable Unit
PAC	Potential Area of Concern
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
pCi/g	picocuries per gram
RFETS	Rocky Flats Environmental Technology Site
SAP	Sampling and Analysis Plan
STP	Sewage Treatment Plant
SW AEU	South Walnut Creek Aquatic Exposure Unit
TEC	threshold effect concentration
UBC	Under Building Contamination
UCL	upper confidence limit
UTL	upper tolerance limit
WQCC	Water Quality Control Commission

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1.0 INTRODUCTION AND SITE SETTING

The purpose of this document is to provide a summary of potential ecological risk for the Individual Hazardous Substance Site (IHSS) Group NE-1 areas of interest (Ponds B-4 and B-5) for the South Walnut Creek Aquatic Exposure Unit (EU) (AEU) (SW AEU). In order to accomplish this task, the Comprehensive Risk Assessment (CRA) Methodology (DOE 2004a) was followed, in which the SW AEU was evaluated for the entire AEU. Through this process ecological contaminants of potential concern (ECOPCs) are identified and their locations within the drainage are determined. This process focuses on contaminants of potential concern that would occur in the ponds within the SW AEU while following the drainage-wide approach which focuses upon the ecological endpoint of protecting aquatic populations throughout the AEU.

This document summarizes the identification of the ECOPCs identified by the CRA Methodology (DOE 2004a) process that could pose a risk to aquatic receptors if all materials associated with the SW AEU were left in place. This document represents a component of work outlined within Industrial Area (IA) and Buffer Zone (BZ) Sampling and Analysis Plan (SAP) (IABZSAP) Appendix D (DOE 2004b), which addresses the accelerated action process. A complete risk assessment of the SW AEU will be provided in Volume 15 of the CRA.

Standard risk characterization techniques were applied to determine which of the ECOPCs have the potential to cause risk to the population of aquatic receptors in the South Walnut Creek drainage. Further analysis techniques, such as frequency of detection and spatial extent, and results of other studies were also included as additional lines of evidence from the CRA Methodology. Section 2.0 provides a summary of the ECOPC process, and Section 3.0 summaries the conclusions.

South Walnut Creek is a portion of the watershed that provides the major drainage for the north-central portion of the Rocky Flats Environmental Technology Site (RFETS) including the majority of the IA. The boundaries of the South Walnut Creek AEU are shown on Figure B-1. South Walnut Creek has five retention ponds (Ponds B-1, B-2, B-3, B-4, and B-5). Ponds B-4 and B-5 are shown on Figure 1of the Data Summary Report (DSR). The section of the stream upgradient from Pond B-5 is classified as stream Segment 5 in the Big Dry Creek basin by the Colorado Water Quality Control Commission (WQCC). Downstream from Pond B-5, South Walnut Creek is classified as stream Segment 4b.

The flow in South Walnut Creek has been highly dependent on effluent from the former Sewage Treatment Plant (STP), stormwater runoff from the IA, and management of the ponds. This AEU has continuous flows immediately downstream of the IA until the last retention pond, Pond B-5. Below Pond B-5, the aquatic environment is totally dependent upon periodic releases from the pond. Between batch releases from the terminal ponds (B-5 and A-4), the lower section of Walnut Creek is often dry. The hydrology of South Walnut Creek is expected to change in response to the ongoing accelerated actions that include removal of buildings within the IA and the elimination of water historically imported for RFETS operations. This includes the elimination of the STP discharge and removal of buildings and pavement from within the IA. All of these efforts combined are expected to create a decrease in flows within South Walnut Creek.

Native fish species are found in the South Walnut Creek ponds and specific sections of the stream (DOE 2003). Fathead minnows (*Pimephales promelas*) are present in the B ponds, the stream between Ponds B-4 and B-5 and in Lower Walnut Creek. A variety of non-native fish species including rainbow trout (*Salmo gairdneri*), carp (*Cyprinus carpio*), and bass (*Micropterus* sp.) were introduced into the ponds at various times; however, no introductions have led to establishing reproducing fish populations in the B ponds.

Within the Walnut Creek area, the most common aquatic macroinvertebrates are the larvae of the blackfly (Order *Diptera, Simulidae* sp.), midge (Order *Diptera, Chironomidae* sp.), mayfly (Order *Ephemeroptera*) (DOE 1995), and scuds (*Hyallela azteca*) (DOE 2003). Other species include caddisflies (Order *Trichoptera*), craneflies (*Tipulidae* ssp.), and damselfly larvae (Order *Odonata*), as well as snails (Class *Gastropoda*) and other amphipods (Order *Amphipoda*). Large macroinvertebrate species such as those present within the Walnut Creek area, including crayfish (Order *Decapoda,* Family *Astacidae*) and snails, are potentially important prey for other fish, waterfowl, and mammal species.

Characterization of the aquatic habitat provided by South Walnut Creek is of primary consideration with regards to aquatic risk. Attachment 1 provides a more detailed summary of the AEU ecological setting. Currently sustained flows exist, albeit minimal in nature that support some aquatic species. Given the nature of ongoing accelerated actions, the location and amount of viable aquatic habitat that will be present after accelerated actions are complete is unclear because overland flow will be altered by the IA accelerated actions and the removal of buildings and pavement.

2.0 ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IDENTIFICATION AND RISK CHARACTERIZATION

The methods and results of both the ECOPC and risk characterization process for sediment are described below. The process follows the CRA Methodology. Data for the SW AEU were evaluated to determine whether they were adequate for the CRA and for this evaluation. Data were determined adequate and the data adequacy evaluation is described in Volume 2 of the CRA (DOE 2005).

2.1 Ecological Contaminants of Potential Concern Identification Process and Results

Table B-1 summarizes the results of the sediment ECOPC identification process. The results of each successive step involved in the process are outlined within this table. The methods involved with each step and their outcome are described below.

The first step in the ECOPC identification process is a comparison of maximum detected concentrations (MDCs) of the ecological contaminants of interest (ECOIs) to the CRA Methodology-defined ecological screening levels (ESLs). If an MDC exceeds the ESL, the ECOI is retained for further analysis. Those ECOIs that have no ESLs available are

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retained for further assessment as ECOIs of uncertain toxicity in the uncertainty section of the CRA (Volume 15b) and will not be discussed further in this document.

Table B-1
ECOPC Screening Step for Sediment in the SW AEU

ECOI	MDC	Sediment ESL	MDC> ESL?	Frequency of Detection	DF > 5%?	> BKG?	95th UTL > ESL?	ECOPC?
Inorganics (mg/kg)								
Aluminum	28000	15900	Yes	100%	Yes	Yes	Yes	**Yes**
Antimony	25.6	2	Yes	20%	Yes	No	Yes	No
Arsenic	21.6	9.79	Yes	93%	Yes	Yes	No	No
Barium	196	189	Yes	100%	Yes	Yes	No	No
Beryllium	2.2	N/A	N/A	50%	Yes	No	N/A	No
Boron	4.4	N/A	N/A	70%	Yes	Yes	N/A	No
Cadmium	6.2	0.99	Yes	31%	Yes	No	N/A	No
Calcium	95700	N/A	N/A	100%	Yes	Yes	N/A	No
Cesium	13.6	N/A	N/A	28%	Yes	No	N/A	No
Chromium	49	43.4	Yes	92%	Yes	Yes	No	No
Chromium VI	0.013	43.4	No	38%	Yes	Yes	N/A	No
Cobalt	13.3	N/A	N/A	83%	Yes	Yes	N/A	No
Copper	324	31.6	Yes	93%	Yes	Yes	Yes	**Yes**
Fluoride	9.27	0.01	Yes	50%	Yes	Yes	Yes	**Yes**
Iron	32400	20000	Yes	100%	Yes	Yes	No	No
Lead	170	35.8	Yes	100%	Yes	Yes	Yes	**Yes**
Lithium	23.5	N/A	N/A	79%	Yes	No	N/A	No
Magnesium	22900	N/A	N/A	100%	Yes	Yes	N/A	No
Manganese	639	630	Yes	100%	Yes	No	N/A	No
Mercury	0.23	0.18	Yes	19%	Yes	No	N/A	No
Molybdenum	2.9	N/A	N/A	11%	Yes	No	N/A	No
Nickel	216	22.7	Yes	90%	Yes	Yes	No	No
Nitrate (as nitrogen)	0.776	N/A	N/A	33%	Yes	N/A	N/A	No
Nitrate / Nitrite	3	N/A	N/A	58%	Yes	N/A	N/A	No
Potassium	3890	N/A	N/A	98%	Yes	Yes	N/A	No
Selenium	0.93	0.95	No	8%	Yes	Yes	N/A	No
Silver	102	1	Yes	16%	Yes	No	N/A	No
Sodium	922	N/A	N/A	85%	Yes	Yes	N/A	No
Strontium	149	N/A	N/A	100%	Yes	Yes	N/A	No
Thallium	0.98	N/A	N/A	18%	Yes	Yes	N/A	No
Tin	39.5	N/A	N/A	7%	Yes	No	N/A	No
Titanium	330	N/A	N/A	100%	Yes	Yes	N/A	No
Vanadium	47.8	N/A	N/A	96%	Yes	Yes	N/A	No
Zinc	888	121	Yes	100%	Yes	Yes	N/A	**Yes**
Organics (ug/kg)								
1,2,4-Trichlorobenzene	2	429	No	1%	No	N/A	N/A	No
2-Butanone	51	N/A	N/A	17%	Yes	N/A	N/A	No
2-Methylnaphthalene	41	20.2	Yes	1%	No	N/A	N/A	No

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ECOI	MDC	Sediment ESL	MDC> ESL?	Frequency of Detection	DF > 5%?	> BKG?	95th UTL > ESL?	ECOPC?
4,4'-DDE	4.1	3.16	Yes	2%	No	N/A	N/A	No
4-Methylphenol	47	12.3	Yes	1%	No	N/A	N/A	No
Acenaphthene	180	6.71	Yes	17%	Yes	N/A	Yes	**Yes**
Acetone	210	N/A	N/A	9%	Yes	N/A	N/A	No
Anthracene	430	57.2	Yes	33%	Yes	N/A	Yes	**Yes**
Benzo(a)anthracene	1400	108	Yes	46%	Yes	N/A	Yes	**Yes**
Benzo(a)pyrene	1300	150	Yes	45%	Yes	N/A	Yes	**Yes**
Benzo(b)fluoranthene	1500	N/A	N/A	57%	Yes	N/A	N/A	No
Benzo(g,h,i)perylene	270	13	Yes	27%	Yes	N/A	Yes	**Yes**
Benzo(k)fluoranthene	920	240	Yes	54%	Yes	N/A	Yes	**Yes**
Benzoic Acid	1400	N/A	N/A	13%	Yes	N/A	N/A	No
Benzyl Alcohol	41	N/A	N/A	2%	No	N/A	N/A	No
beta-BHC	28	2.37	Yes	2%	No	N/A	N/A	No
bis(2-Ethylhexyl)phthalate	8800	24900	No	65%	Yes	N/A	N/A	No
Bromomethane	5	3.43	Yes	7%	Yes	N/A	Yes	**Yes**
Butylbenzylphthalate	1700	11400	No	10%	Yes	N/A	N/A	No
Carbazole	290	25.2	Yes	38%	Yes	N/A	Yes	**Yes**
Carbon Tetrachloride	440	7890	No	3%	No	N/A	N/A	No
Chloroform	2	N/A	N/A	6%	Yes	N/A	N/A	No
Chrysene	1400	166	Yes	61%	Yes	N/A	Yes	**Yes**
Dibenz(a,h)anthracene	360	33	Yes	13%	Yes	N/A	Yes	**Yes**
Dibenzofuran	65	325	No	6%	Yes	N/A	N/A	No
Dieldrin	4.6	N/A	N/A	2%	No	N/A	N/A	No
Diethylphthalate	53	108	No	2%	No	N/A	N/A	No
Dimethylphthalate	490	N/A	N/A	6%	Yes	N/A	N/A	No
Di-n-butylphthalate	68	612	No	12%	Yes	N/A	N/A	No
Di-n-octylphthalate	620	N/A	N/A	17%	Yes	N/A	N/A	No
Ethylbenzene	9	N/A	N/A	3%	No	N/A	N/A	No
Fluoranthene	2700	423	Yes	69%	Yes	N/A	Yes	**Yes**
Fluorene	180	77.4	Yes	13%	Yes	N/A	Yes	**Yes**
gamma-BHC (Lindane)	25	2.37	Yes	2%	No	N/A	N/A	No
Heptachlor epoxide	33	2.47	Yes	2%	No	N/A	N/A	No
Hexachlorobutadiene	2	23	No	1%	No	N/A	N/A	No
Indeno(1,2,3-cd)pyrene	910	17	Yes	41%	Yes	N/A	Yes	**Yes**
Methoxychlor	2.7	24	No	2%	No	N/A	N/A	No
Methylene Chloride	420	N/A	N/A	22%	Yes	N/A	N/A	No
Naphthalene	120	176	No	8%	Yes	N/A	N/A	No
Aroclor-1254	1700	40	Yes	25%	Yes	N/A	Yes	**Yes**
Aroclor-1260	2000	40	Yes	6%	Yes	N/A	Yes	**Yes**
Pentachlorophenol	1100	255	Yes	4%	No	N/A	N/A	No
Phenanthrene	1800	204	Yes	60%	Yes	N/A	Yes	**Yes**
Phenol	110	773	No	1%	No	N/A	N/A	No
Pyrene	1700	195	Yes	66%	Yes	N/A	Yes	**Yes**
Tetrachloroethene	7	3050	No	5%	Yes	N/A	N/A	No
Toluene	360	1660	No	22%	Yes	N/A	N/A	No

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ECOI	MDC	Sediment ESL	MDC> ESL?	Frequency of Detection	DF > 5%?	> BKG?	95th UTL > ESL?	ECOPC?
Radionuclides (pCi/g)								
Americium-241	7.452	5150	No	72%	Yes	Yes	N/A	No
Cesium-137	0.9586	3120	No	63%	Yes	No	N/A	No
Gross Alpha	160	N/A	N/A	100%	Yes	No	N/A	No
Gross Beta	125.2	N/A	N/A	100%	Yes	No	N/A	No
Plutonium-239/240	24.09	5860	No	83%	Yes	Yes	N/A	No
Radium-226	1.593	101	No	100%	Yes	No	N/A	No
Radium-228	2.082	87.8	No	100%	Yes	No	N/A	No
Strontium-89/90	0.047	582	No	100%	Yes	Yes	N/A	No
Uranium-233/234	9.807	N/A	N/A	100%	Yes	No	N/A	No
Uranium-235	0.8517	3730	No	68%	Yes	No	N/A	No
Uranium-238	59	2490	No	100%	Yes	No	N/A	No

The ECOIs were further evaluated based on their frequency of detection. For sediment, there were several ECOIs detected in less than 5 percent of the sediment samples. These ECOIs and corresponding figures include 2-methylnaphthalene (Figure B-1), 4,4'-DDE (Figure B-2), 4-methylphenol (Figure B-3), beta-BHC (Figure B-4), gamma-BHC (Figure B-5), heptachlor epoxide (Figure B-6), and pentachlorophenol (Figure B-7).

Based on a review of the spatial extent of these chemicals (Figures B-1 through B-7), most of these ECOIs are located outside of the stream channel, and are not typically associated with the ponds, the exception being gamma-BHC with a single measured value in Pond B-4, and pentachlorophenol with a single measured value in Pond B-1. These chemicals also occur in only one location. For an impact to occur to an aquatic population within a pond, there needs to be a more expansive spatial extent of a given chemical at concentrations of potential concern. This is not the case for these chemicals. They occur in a single location and usually outside of habitat areas. These ECOIs are eliminated from further consideration in South Walnut Creek because they are unlikely to present risks to the population of receptors that may inhabit the drainage as a whole, and the ponds in particular. No depositional trends were found at Pond B-5.

The distributions of the inorganic ECOIs were also evaluated relative to the distribution of ECOI concentrations in the site-specific background sets. The background comparison step follows the process agreed to through the consultative process with agencies and documented in Volume 2 of the CRA.

Of the remaining inorganic ECOIs in sediment, antimony, cadmium, manganese, mercury, and silver occurred at concentrations that were not significantly greater than concentrations in the sitewide background sediment data set. These metals were eliminated from further consideration because the risk posed by them would not exceed the risk already associated with background conditions.

The final step in the ECOPC identification process involved calculating an upper-bound exposure point concentration (EPC) for all remaining ECOIs, which was then compared to the CRA Methodology ESL. This EPC is calculated as the 95th upper tolerance limit (UTL) (95^{th} upper confidence limit [UCL] of the 90^{th} percentile). Where sufficient data were unavailable to calculate statistical parameters, the MDC was used as the default EPC. The EPC was then compared to the ESLs from the CRA Methodology. EPCs that exceed their respective ESLs for a given ECOI are identified as final ECOPCs and are discussed further in this assessment.

The maximum EPCs for arsenic, barium, chromium, iron, and nickel in sediment were greater than their respective ESLs. However, the UTL EPCs for these ECOIs were less than the ESLs. Therefore, in accordance with the CRA Methodology, these chemicals were removed from further evaluation. To further ensure that these ECOIs were not a risk concern in sediment for an isolated aquatic population of South Walnut Creek, the spatial distributions of these ECOIs were evaluated by plotting the measured concentrations compared to the ESL and a toxicity threshold (typically representative of a lowest observed adverse effect level [LOAEL] or other applicable value). Attachment 2 provides a summary description of the toxicity thresholds and their endpoints. The CRA Methodology ESL represents a conservative benchmark for screening comparisons, while the toxicity threshold represents a less conservative benchmark correlating to a mid-range, or lowest effect level concentration. Comparison of an EPC to both the ESL and toxicity threshold helps to put into perspective the risk potential attributable to a given ECOPC. The distributions of these chemicals are shown on Figures B-8 through B-12 and then typically occur at concentrations less than the ESLs. Arsenic and chromium each have a single measured concentration above the ESL, which occurs within the portion of the IA that overlaps the SW AEU. These measured values do not occur in ponds. Barium, iron, and nickel have three to five measured values that exceed above the ESLs. The spatial distribution of these values above the ESLs does not demonstrate deposition within pond areas. A single measured value of barium and iron above ESL values occurs within Pond B-4. However, these are single values, while the majority of the remaining data occur below ESL values. Because the distribution of these metals is not concentrated in pond areas, their effects to any single aquatic population such as those within the ponds would be low and, therefore, no further evaluation was conducted.

2.2 Risk Characterization

The ECOPC identification process defined the steps necessary to identify those chemicals that could not reliably be removed from further consideration in the ecological screening process. The list of ECOPCs represents those chemicals in the AEU that require further assessment by means of the risk characterization, as presented in this document. The sediment ECOPCs requiring further evaluation included the following:

- Aluminum;
- Copper;
- Fluoride;
- Lead;
- Zinc;
- Acenaphthene;
- Anthracene;
- Benzo(a)anthracene;
- Benzo(a)pyrene;

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- Benzo(g,h,i)perylene;
- Benzo(k)fluoranthene;
- Bromomethane;
- Carbazole;
- Chrysene;
- Dibenz(a,h)anthracene;
- Fluoranthene;
- Fluorene;
- Indeno(1,2,3-cd)pyrene;
- Aroclor-1254;
- Aroclor-1260;
- Phenanthrene; and
- Pyrene.

For the purposes of this risk characterization, all available sediment data for the SW AEU were used. The UTL ECOPC concentrations were used as the EPCs. If the UTL result was greater than the MDC, the observed MDC was used as the EPC for the risk estimation.

Several lines of evidence were compiled to complete the risk characterization of the SW AEU. The following strategies were applied:

1. Using the hazard quotient (HQ) method, both the UTL (or maximum, whichever was less) and 95% UCL on the mean EPC were compared to the original ESL and the appropriate chemical toxicity threshold (Table B-2). The HQs were developed using the following standard equation: EPC/ESL or Toxicity Threshold = HQ. Only those chemicals that yielded HQs greater than 1 using the ESL for both the UTL and 95% UCL EPC were retained for further analysis (Step 2 below).

2. For the purposes of the ecological screen, only those ECOPCs requiring extensive risk characterization were mapped (Figures B-13 through B-31). Each sample location with a detected ECOPC value is shown. The result is compared to appropriate ESLs, and defined as having low (less than the CRA Methodology-defined ESL, no observed adverse effect level [NOAEL], or equivalent), low-to-moderate (greater than the CRA Methodology, but less than the toxicity threshold), or moderate (greater than the toxicity threshold which is equivalent to a LOAEL or similar value) risk potential.

2.3 Results of the Hazard Quotient Analysis

Results of the HQ analysis for sediment indicated the following:

- The risk potential attributable to aluminum, copper, lead, benzo(k)fluoranthene, and bromomethane would be low because HQ values were at or below 1 for ESLs and toxicity thresholds.

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Table B-2
HQs for Sediment ECOPCs in the SW AEU

ECOPC[a]	Unit	ESL	Toxicity Threshold	95 UTL EPC HQs			95 UCL EPC HQs			Further Characterization Required?
				EPC	ESL-HQ	Tox Threshold-HQ	EPC	ESL-HQ	Tox Threshold-HQ	
Aluminum	mg/kg	15900	58000	17900	1	0.3	8830	1	0.2	No
Copper	mg/kg	31.6	149	33	1	0.2	36.5	1.1	0.2	No
Fluoride	mg/kg	0.01	7	9.27	**927**	1	5.32	**532**	1	Yes
Lead	mg/kg	35.8	128	53.4	1	0.4	28.5	1	0.2	No
Zinc	mg/kg	121	459	375	**3**	1	236	**2**	1	Yes
Acenaphthene	ug/kg	6.71	1300	180	**27**	0.1	252	**38**	0.2	Yes
Anthracene	ug/kg	57.2	845	345	**6**	0.4	242	**4**	0.3	Yes
Benzo(a)anthracene	ug/kg	108	1050	820	**8**	1	426	**4**	0.4	Yes
Benzo(a)pyrene	ug/kg	150	1450	810	**5**	1	438	**3**	0.3	Yes
Benzo(g,h,i)perylene	ug/kg	13	280	270	**21**	1	254	**20**	1	Yes
Benzo(k)fluoranthene	ug/kg	240	750	460	2	1	308	1	0.4	No
Bromomethane	ug/kg	3.43	NA	5	1	NA	3.89	1	NA	No
Carbazole	ug/kg	25.2	1600	290	**12**	0.2	224	**9**	0.1	Yes
Chrysene	ug/kg	166	1290	650	**4**	1	418	**3**	0.3	Yes
Dibenz(a,h)anthracene	ug/kg	33	230	345	**10**	2	246	**7**	1	Yes
Fluoranthene	ug/kg	423	2230	1400	**3**	1	886	**2**	0.4	Yes
Fluorene	ug/kg	77.4	536	180	**2**	0.3	237	**3**	0.4	Yes
Indeno(1,2,3-cd)pyrene	ug/kg	17	250	405	**24**	2	301	**18**	1	Yes
Aroclor-1254	ug/kg	40	300	560	**14**	2	320	**5**	1	Yes
Aroclor-1260	ug/kg	40	200	205	**5**	1	245	**49**	1	Yes
Phenanthrene	ug/kg	204	1170	760	**4**	1	505	**2**	0.4	Yes
Pyrene	ug/kg	195	1520	1200	**6**	1	602	**3**	0.4	Yes

[a] Bold chemicals require further risk characterization.

- Sediment ECOPCs that require further analysis include fluoride, zinc, acenaphthene, anthracene, benzo(a)anthracene, benzo(a)pyrene, benzo(g,h,i)perylene, carbazole, chrysene, dibenz(a,h)anthracene, fluoranthene, fluorene, indeno(1,2,3-cd)pyrene, Aroclor-1254, Aroclor-1260, phenanthrene, and pyrene.

2.3.1 Results of the Spatial Extent Analysis

The spatial extent of the sediment ECOPCs yielding elevated HQs is illustrated on Figures B-13 through B-31. The spatial extent of these chemicals demonstrates similar trends as follows:

- For acenaphthene (Figure B-15), fluorene (Figure B-24), and Aroclor-1260 (Figure B-27), the observed concentrations generally occur below ESL levels (for acenaphthene and fluorene) indicating a low risk potential, or occur predominantly below detection limits (Aroclor-1260) indicating a low risk potential. There is no depositional trend for these chemicals that would create isolated areas, such as a pond, to be affected. The risk to a population within South Walnut Creek is low and the risk to an aquatic population within a pond area is also low. There is no further evaluation required.

- For fluoride (Figure B-13), carbazole (Figure B-20), and dibenzo(a,h)anthracene (Figure B-22), the measured concentrations within the drainage were predominantly below ESL levels indicating a low risk potential. The only locations with measured values greater than the ESLs occurred where the IA overlapped with SW AEU. The risk to aquatic populations within the drainage would be low because the concentrations of concern occur in areas outside of habitat setting. The risk to an aquatic population within a pond area is low and no further evaluation is required.

- Zinc (Figure B-14), anthracene (Figure B-16), benzo(a)anthracene (Figure B-17), benzo(a)pyrene (Figure B-18), benzo(g,h,i)perylene (Figure B-19), chrysene (Figure B-21), fluoranthene (Figure B-23), indeno(1,2,3-cd)pyrene (Figure B-25), Aroclor-1254 (Figure B-26), phenanthrene (Figure B-28), and pyrene (Figure B-29) occur at concentrations less than the ESLs throughout the drainage indicating a low risk potential. There are several locations within Pond B-4 that have measured concentrations greater than the ESLs indicating a low-to-moderate or moderate risk potential. Because there is a co-location of multiple measured concentrations above the screening threshold, further evaluation is warranted.

- Aroclor-1254 was further evaluated because a depositional trend of elevated concentrations was noted in Pond B-4. Figure B-30 depicts the spatial extent of Aroclor-1254 and the measured concentrations throughout the SW AEU. Figure B-30 shows the measured values in surface sediment, specifically within Pond B-4. Aroclor-1254 was the only form of polychlorinated biphenyl (PCB) detected in surface sediment. Figure B-30 indicates the measured concentrations within Pond B-4 occur at levels above the ESL of 60 mircrograms per kilogram (μg/kg) and

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below the toxicity threshold of 300 µg/kg. The toxicity threshold represents the value above which adverse effects are expected. All measured concentrations occur below this level.

- Polycyclic aromatic hydrocarbons (PAHs) (acenaphthene, anthracene, benzo[a]anthracene, benzo[a]pyrene, benzo[g,h,i]perylene, chrysene, dibenz[a,h]anthracene, fluoranthene, fluorene, indeno[1,2,3-cd]pyrene, phenanthrene, and pyrene) were mapped in further detail (Figure B-31) for surface sediment, in order to understand the spatial distribution of detected PAHs within Pond B-4. As shown on this figure, the majority of the measured concentrations of PAHs occur within the portion of the IA that overlaps the SW AEU. Few measured values for PAHs were found within the actual drainage portion of the AEU, and very few within the ponds themselves. The actual measured values within the ponds occur below ESL values indicating a low risk potential (Figure B-31).

2.3.2 Additional Analysis of ECOPCs

Certain chemicals were evaluated further to better characterize the potential risk attributable to them in regards to their potential impacts to aquatic populations in ponds. The chemicals requiring further analysis are Aroclor-1254 and PAHs in sediment. Several approaches to understand the risk potential attributable to these chemicals were taken, as described below.

Aroclor-1254

As an additional risk characterization, the maximum total PCB concentration was determined for the entire AEU, as well as for Pond B-4. The results yield a maximum total PCB concentration for the entire AEU of 3,000 µg/kg. This value was based upon the detected values of both Aroclor-1254 and Aroclor-1260. When compared to the total PCB toxicity thresholds described by MacDonald et al. (2000) the AEU maximum total PCB value is greater than the extreme effects concentration (EEC) of 1,700 µg/kg, and greater than the mid-range effect concentration (MEC) of 400 µg/kg. The EEC is defined as the value above which adverse effects can be expected. The MEC is a value above which adverse effects are likely (frequently observed with an incidence of toxicity being more than 50 percent).

Analysis of the pond-specific surface sediment PCB concentrations are shown on Figure B-31. Pond B-4 had a range of detected PCB concentrations from 120 to 220 µg/kg. As shown on this figure, Aroclor-1254 in Pond B-4 has measured values greater than the 40 µg/kg ESL for total PCBs, and the 60 µg/kg Aroclor-1254-specific ESL. All measured values within Pond B-4 were greater than the threshold effect concentration (TEC) of 300 µg/kg, but below the MEC of 400 µg/kg. The 300 µg/kg value represents a toxic effect threshold for Aroclor-1254, above which adverse effects are expected.

Additional lines of evidence gathered from previous studies, such as the in-situ bioassay results from the Operable Unit (OU) 5/OU 6 Watershed Ecological Risk Assessment

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(ERA) (DOE 1995) and the PCB study of Woman and Walnut Creeks (Stiger 1994), add to the conclusion that Aroclor-1254 does not appear to pose a risk to aquatic populations within the pond. Results of the in-situ bioassays revealed no effect. Similarly, benthic macroinvertebrate surveys were conducted as part of the OU 5/OU 6 study that indicated the species composition and aquatic populations are comparable to control settings. In 1994, a study was completed that specifically focused on the spatial extent of PCBs in Woman and Walnut Creek drainages. Sampling of sediment and fish tissues was completed. Results indicated no detectable levels in terminal pond sediments (Pond B-5), and tissue concentrations were below effects thresholds for fish-eating birds. Given these additional lines of evidence, it appears the chemical risk evaluation presents a conservative finding in regards to Aroclor-1254. There does not appear to be a chemical-related impact to the resident populations. These combined lines of evidence indicate sediment ECOPCs do not pose a risk concern to aquatic populations within the ponds.

PAHs

As shown on the sediment ECOPC maps, certain PAHs occur in co-located areas within Pond B-4 (Figure B-31). The measured concentrations are variable, with inconsistent trends. There are no consistently high PAH compounds. When spatially reviewed, the PAHs are shown to predominantly occur within the portion of the IA that overlaps the SW AEU. This demonstrates that the drainage itself contains few of the measured values. Further spatial review of the ponds specifically shows few detected values of PAHs. There are no concentrated areas, or co-located locations with high levels of these chemicals. The spatial extent of PAHs is very limited within the actual aquatic habitat (channel and pond area) regions of the SW AEU.

Further evaluation of the ecological risk condition within Pond B-4 was completed by compiling other lines of evidence gathered from previous studies. The 1995 U.S. Department of Energy (DOE) evaluation of OU 5/OU 6 ecological risk conducted sediment bioassay studies using *Hyallela azteca* and *Chironomus tentans*. Results for Pond B-4 bioassays are as follows:

- For *Hyallela azteca*, test media percent survival was 91percent compared to the controls which yielded a percent survival of 89 percent.
- For *Chironomus tentans*, test media percent survival was 62 percent as compared to the controls which yielded a percent survival of 82 percent.

The results of the bioassay demonstrated no toxicity to *Hyallela* and low toxicity to *Chironomus.* No conclusions were drawn as to the specific sediment stressor that may be causing the effect to *Chironomus.* Given the combined lines of evidence gathered from the previous studies (bioassays) and the low-to-moderate risk range of HQs for the PAHs, it does not appear these chemicals pose a risk to Pond B-4. No further evaluation is required.

3.0 SUMMARY AND CONCLUSIONS

Multiple lines of evidence were gathered to evaluate the aquatic risk conditions within the SW AEU Pond B-4 area. The drainage-wide approach, as described within the CRA Methodology, was followed. After ECOPCs were identified, the specific concerns associated with the pond were evaluated. An evaluation of the risk potential was conducted using a standard HQ approach, along with an evaluation of the spatial extent of certain ECOPCs requiring further analysis. Certain chemicals were carried further by evaluation of other lines of evidence, such as those gathered from previous studies (OU 5/OU 6 Watershed ERA [DOE 1995]).

Of the ECOPCs carried through the process, all were characterized as having low risk potential. The HQ evaluation is a very conservative approach that identifies ECOPCs requiring further evaluation. Of those that were evaluated within the risk characterization, it was determined that there is a low risk potential. In particular, Pond B-4 was not identified as having any particular chemical risk issue.

The spatial distribution evaluation indicated similar trends among the ECOPCs evaluated. There were a few locations where observed concentrations exceeded ESL values. Detailed analysis of certain chemicals indicates the frequency and magnitude of the ECOPCs are not substantial compared to the ESLs and toxicity thresholds. Review of pond-specific conditions identified Aroclor-1254 and PAHs as being a potential chemical risk issue. However, further analysis using other lines of evidence (in-situ bioassay and tissue analysis results) support the conclusion that these chemicals are not of concern.

The aquatic conditions within South Walnut Creek indicate this drainage is controlled by ephemeral flow conditions. The aquatic life within the system is highly susceptible to changes in flow, and in turn is represented as an opportunistic assemblage of aquatic species. There have been no studies to indicate water quality is a controlling factor to the ecology. Instead, it is well documented that flow conditions are the controlling factor that limit the amount of available habitat year-round. Additional details on habitat conditions are found in Attachment 1.

In summary, the lines of evidence support the conclusion that there is a low risk potential to populations of aquatic life within South Walnut Creek as related to the ECOPCs. The overlying risk driver to these organisms is the habitat condition itself.

There are sources of uncertainty associated with this evaluation. For instance, it was assumed that all of South Walnut Creek is viable aquatic habitat and that all areas sampled are equally important to the support of populations. This is a very conservative assumption because areas within South Walnut Creek are limited due to intermittent flows. In the interest of being conservative, however, it was also assumed those ECOPCs in areas that are not suitable habitat (which were sampled due to the presence of sediment, and had a possible connection to the drainage hydrology as a whole) could contribute to possible future exposure conditions to aquatic receptors that reside downgradient of this potential source. This assumption likely overestimates the exposure of these receptors because the hydrologic connectivity is unknown or unlikely. A discussion of historic study findings that evaluate the aquatic condition within South Walnut Creek is provided in Attachment 1.

Another uncertainty is associated with the use and selection of the toxicity thresholds. Toxicity thresholds for sediment reflect various effect conditions depending upon the literature source. If a measured ECOPC concentration occurs above these values, the magnitude of effect attributable to the exposure is unknown. A discussion of the endpoints associated with these toxicity thresholds is provided in Attachment 2.

4.0 REFERENCES

DOE, 2003, Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, Golden, Colorado, 2001-2002.

DOE, 1995, Final Phase 1, RFI/RI Report, Woman Creek Priority Drainage, Operable Unit 5, Appendix N, Ecological Risk Assessment for Walnut Creek and Woman Creek Watersheds at the Rocky Flats Environmental Technology Site, Golden, Colorado, September.

DOE, 2004a, Comprehensive Risk Assessment Work Plan and Methodology, Rocky Flats Environmental Technology Site, Golden, Colorado, September.

DOE, 2004b, Industrial Area and Buffer Zone Sampling and Analysis Plan, Modification 1, Rocky Flats Environmental Technology Site, Golden, Colorado, May.

DOE 2005, Comprehensive Risk Assessment, Rocky Flats Environmental Technology Site, Golden, Colorado (in prep).

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000, "Development and evaluation of consensus-based sediment quality guidelines for fresh water ecosystems," Archives of Environmental Contamination, Toxicology, 39, 20-31.

Stiger, S.G., 1994, Memorandum to Kurt Meunchow and Jessie M. Roberson/Env. Restoration/DOE/RFFO dated October 31, 1994, entitled "Results of PCB Sediment and Tissue Sampling for Walnut and Woman Creek Drainages and Offsite Reservoirs – SGS-576-94. Copy provided in Appendix K of the Final RFI/RI Operable Unit 3 Report.

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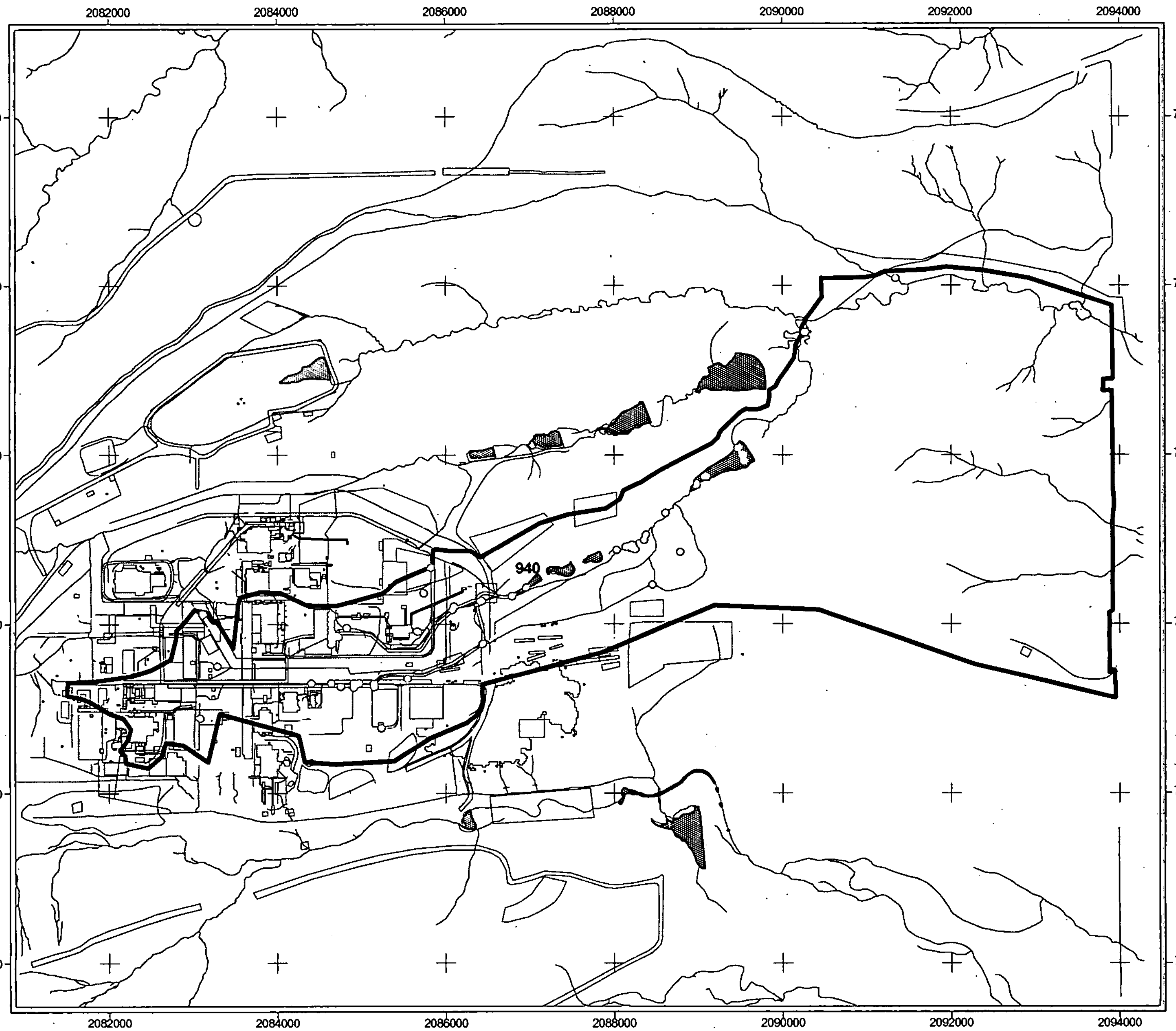

Figure B-1
South Walnut Creek AEU
Sediment Results
for 2-Methylnaphthalene

KEY

1.0 Sample concentration (ug/kg)

Sampling location

O Detect

O Nondetect

Stream

Lake

South Walnut Creek AEU

IHSS/PAC/UBC

ESL = 20.2 ug/kg

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1:22,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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Date: 05/19/05

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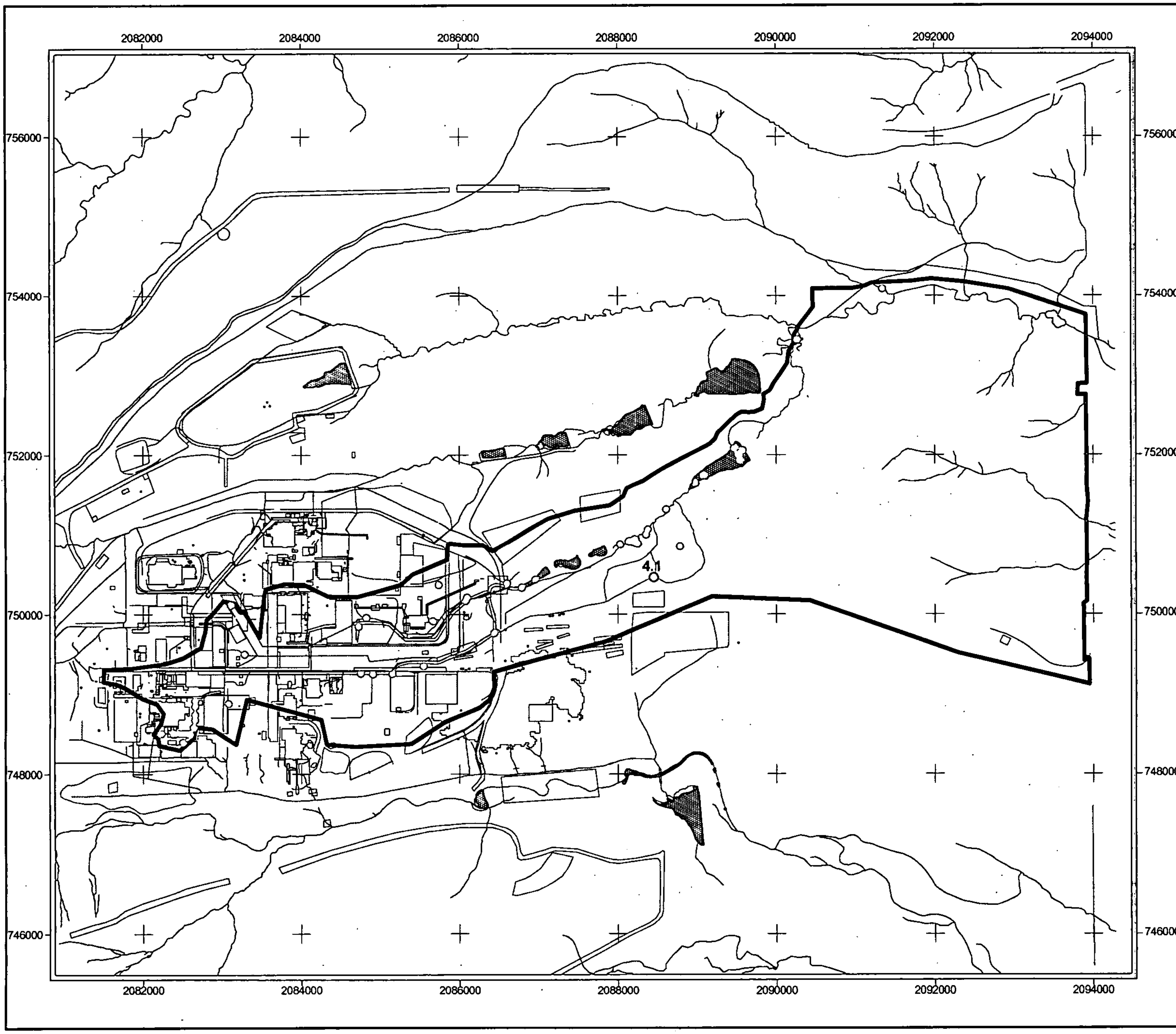

Figure B-2
South Walnut Creek AEU
Sediment Results
for 4,4'-DDE

KEY

1.0 Sample concentration (ug/kg)
Sampling location
O Detect
o Nondetect
Stream
Lake
South Walnut Creek AEU
IHSS/PAC/UBC

ESL = 3.16 ug/kg

DRAFT

Data Set: 12/15/04

N
W E
S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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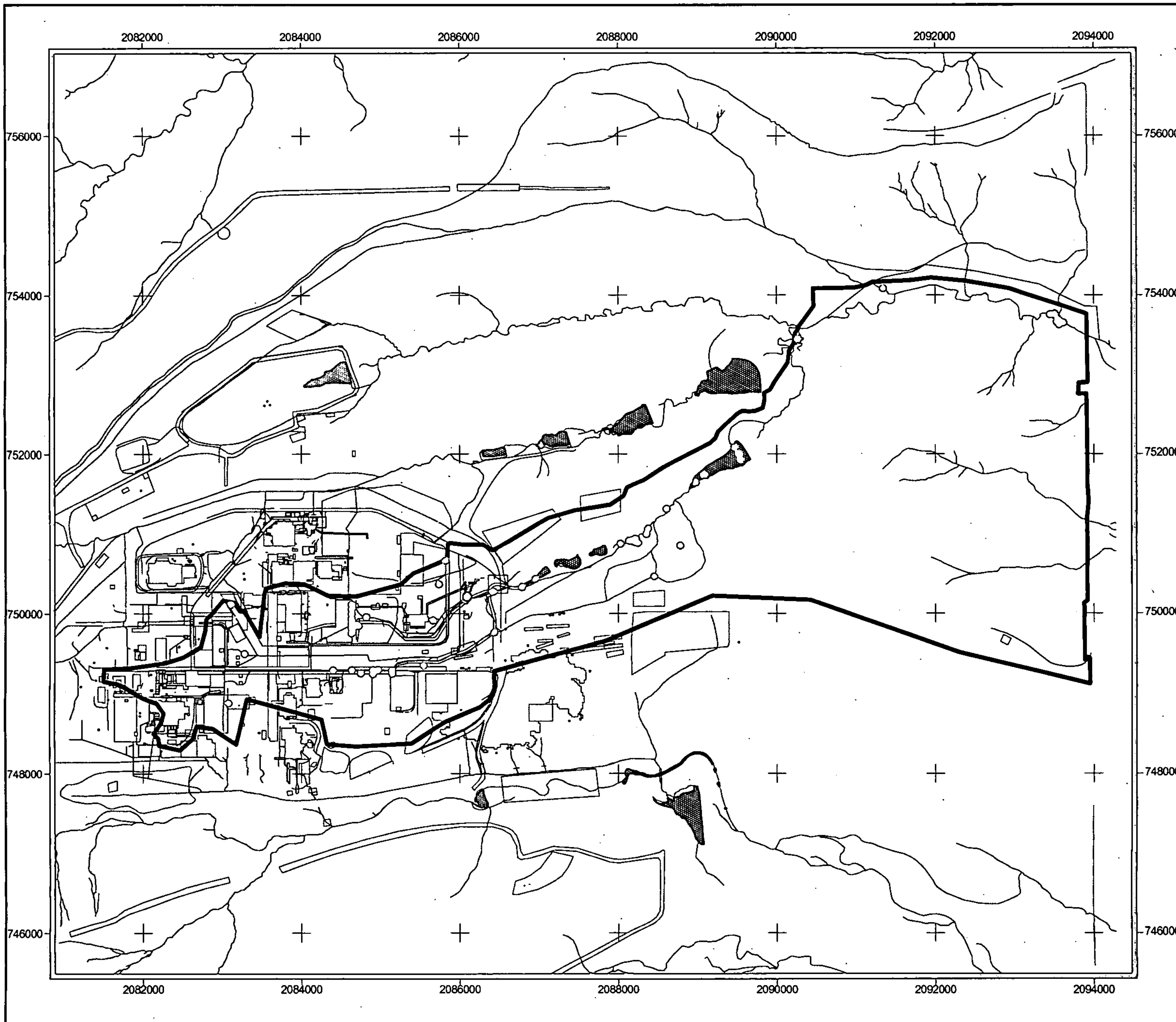

Figure B-3
South Walnut Creek AEU
Sediment Results
for 4-Methylphenol

KEY

1.0 Sample concentration (ug/kg)
Sampling location
O Detect
O Nondetect
Stream
Lake
South Walnut Creek AEU
IHSS/PAC/UBC

ESL = 12.3 ug/kg

DRAFT

Data Set: 12/15/04

N
W E
S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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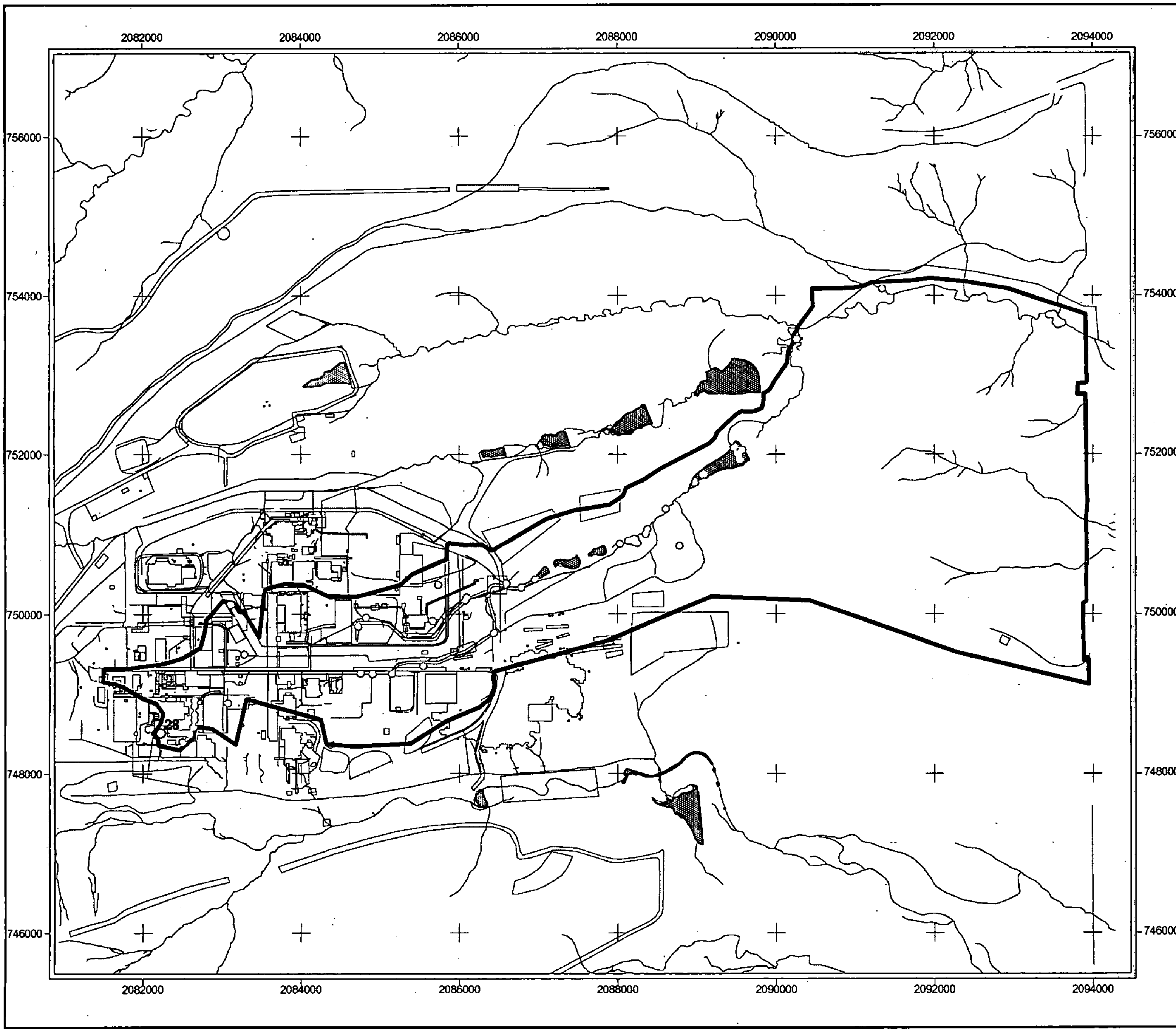
Figure B-4
South Walnut Creek AEU
Sediment Results
for Beta-BHC



KEY

1.0 Sample concentration (ug/kg)

Sampling location
- Detect
- Nondetect
- Stream
- Lake
- South Walnut Creek AEU
- IHSS/PAC/UBC

ESL = 2.37 ug/kg

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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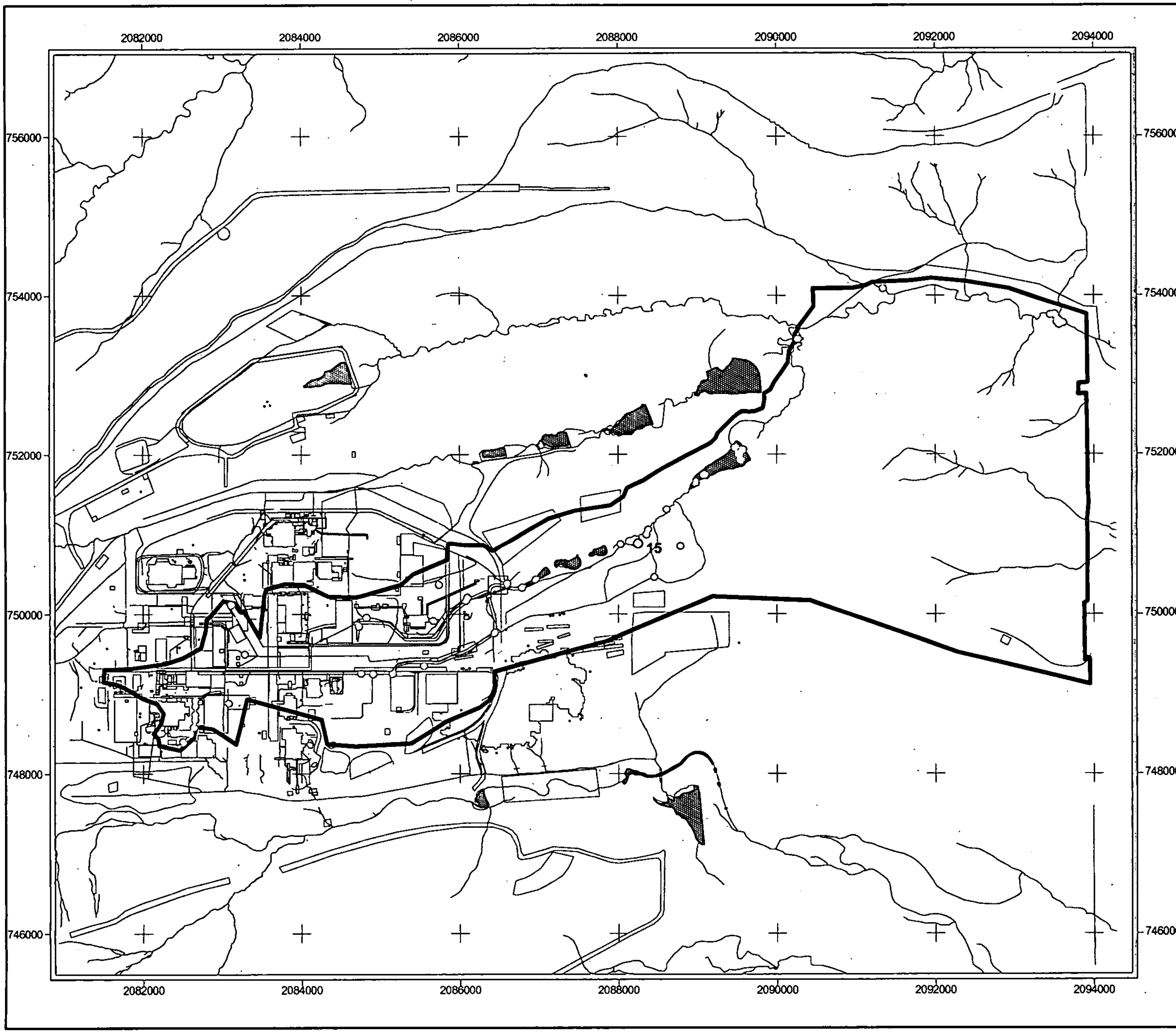

Figure B-5
South Walnut Creek AEU
Sediment Results
for Gamma-BHC

KEY

1.0 Sample concentration (ug/kg)
Sampling location
O Detect
O Nondetect
Stream
Lake
South Walnut Creek AEU
IHSS/PAC/UBC

ESL = 2.37 ug/kg

DRAFT

Data Set: 12/15/04

N
W E
S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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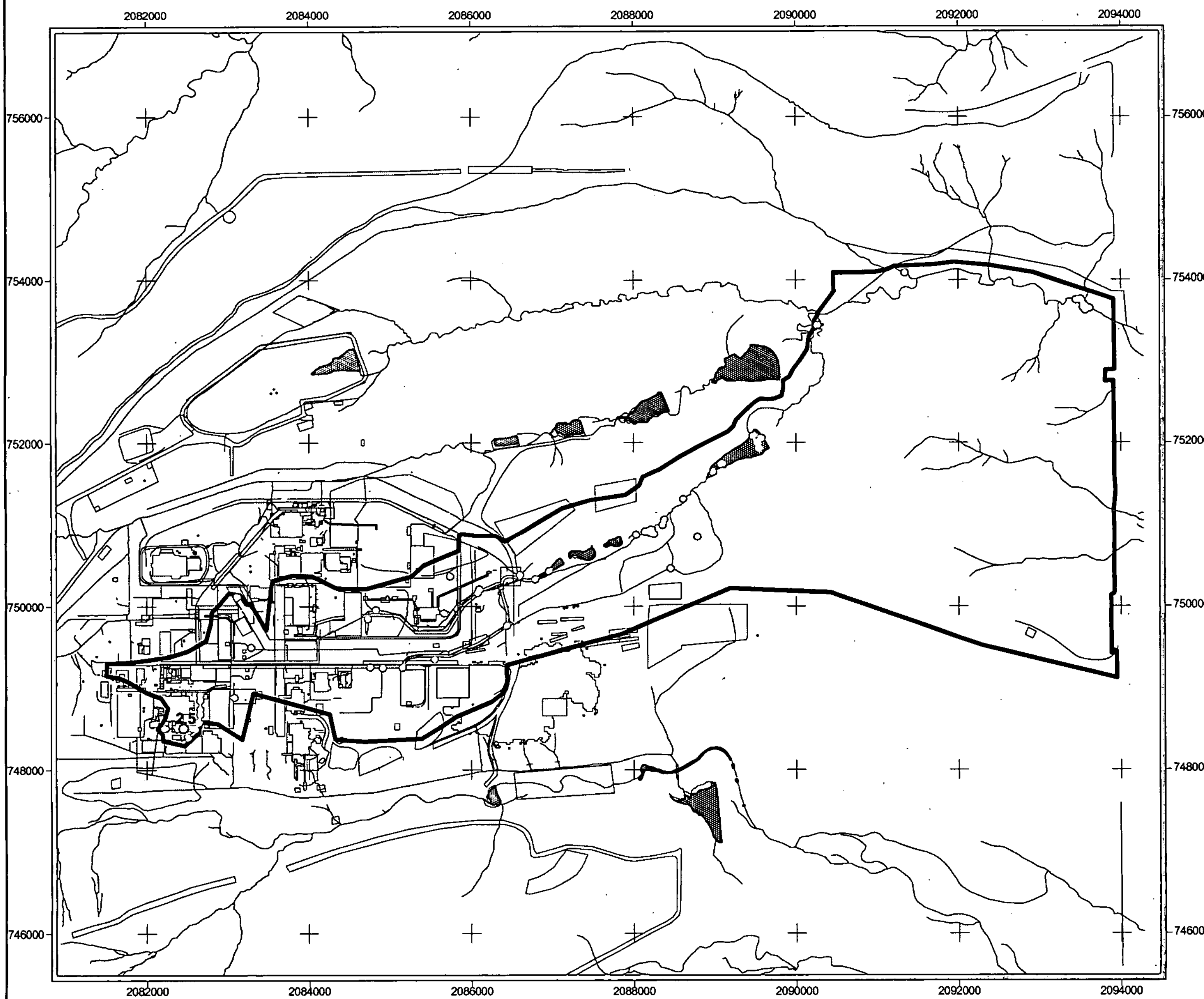
Figure B-6
South Walnut Creek AEU
Sediment Results
for Heptachlor Epoxide



KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Detect
- Nondetect

Stream

Lake

South Walnut Creek AEU

IHSS/PAC/UBC

ESL = 2.47 ug/kg

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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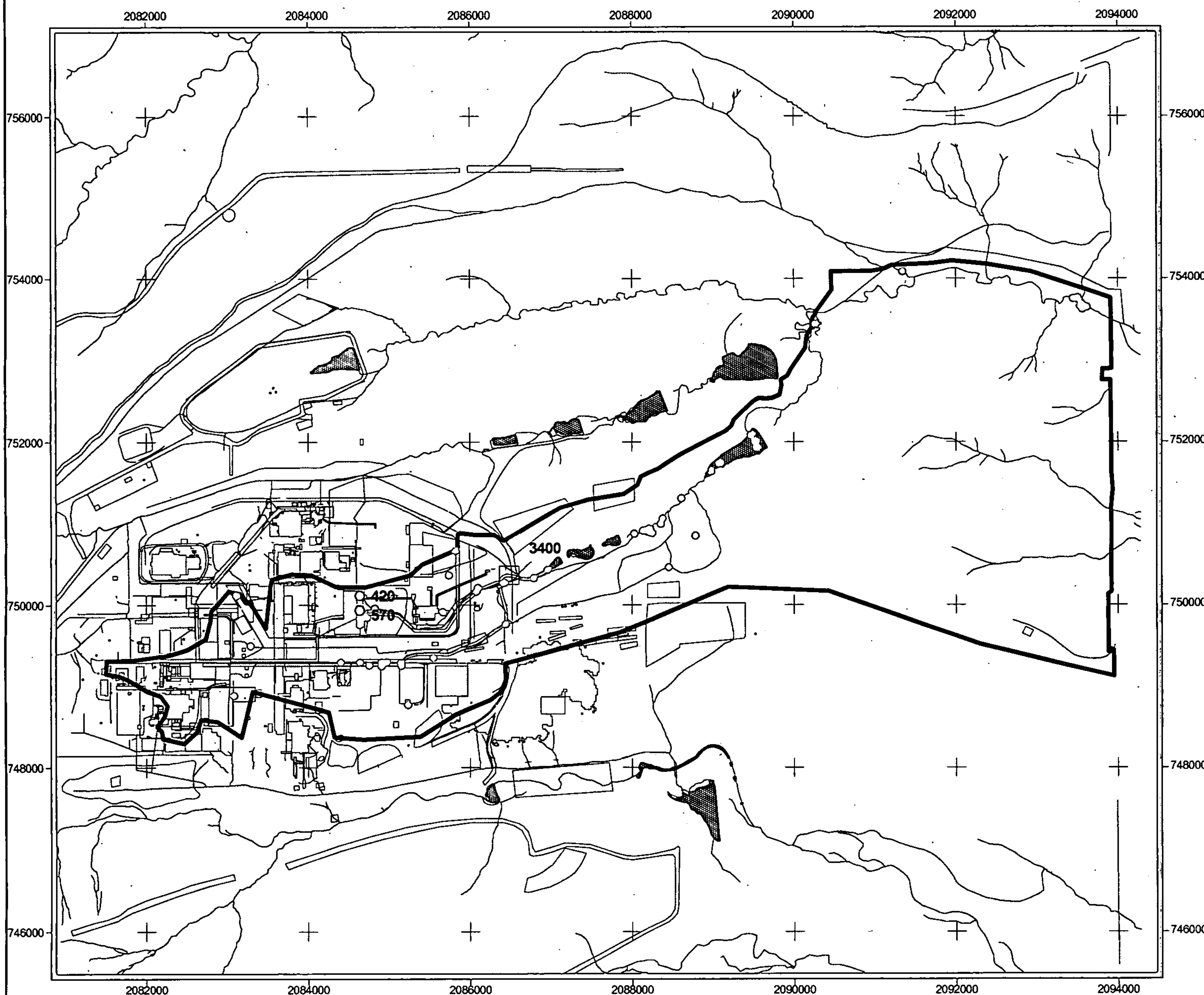
Figure B-7
South Walnut Creek AEU
Sediment Results for Pentachlorophenol



KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Detect
- Nondetect
- Stream
- Lake
- South Walnut Creek AEU
- IHSS/PAC/UBC

ESL = 255 ug/kg

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000

State Plane Coordinate Projection
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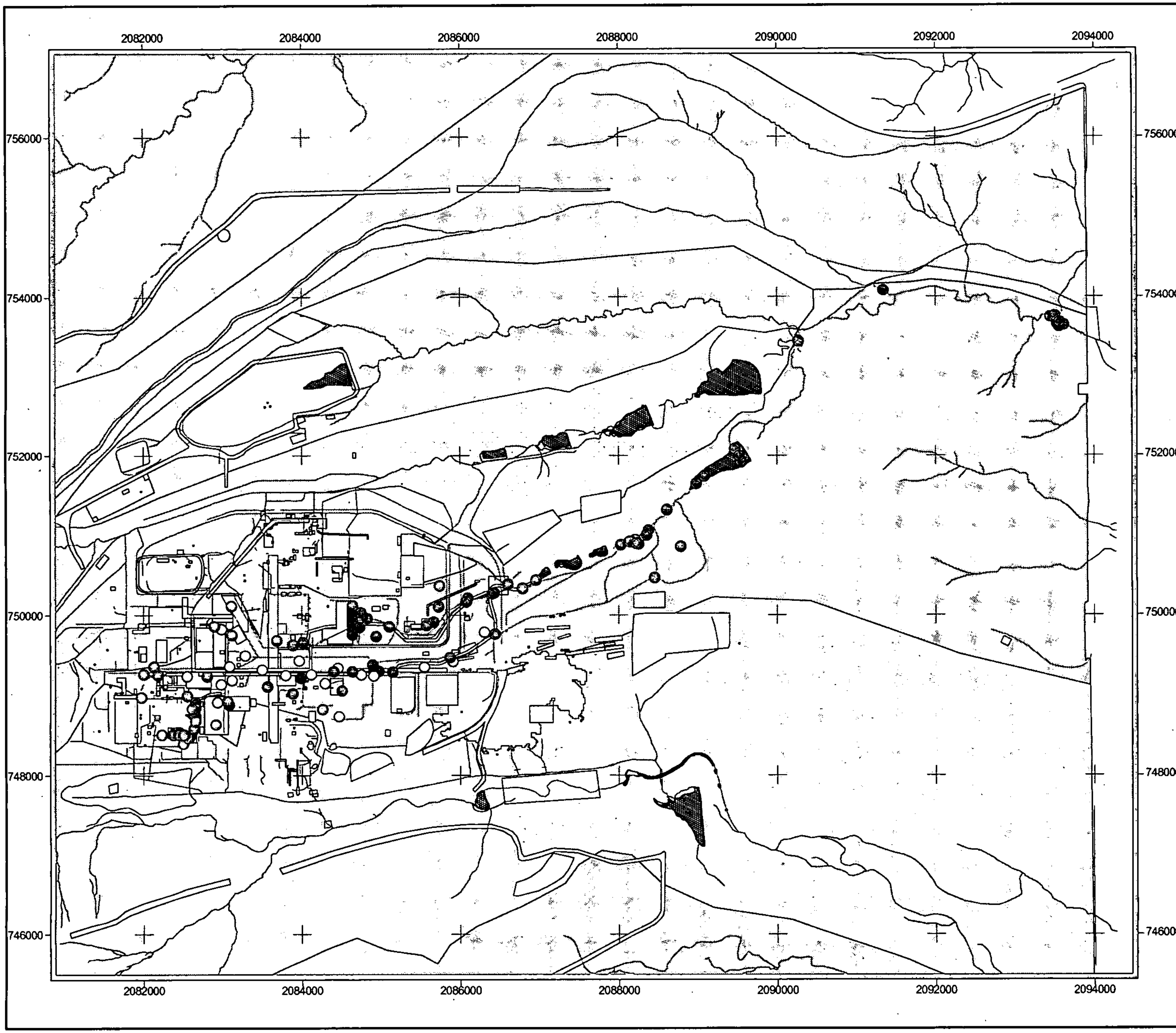

Figure B-8
South Walnut Creek AEU
Sediment Sampling Locations for
Arsenic

KEY

Sampling location

- Moderate potential (>toxicity threshold = 33 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>9.79 and <33 mg/kg)
- Low potential (<ESL = 9.79 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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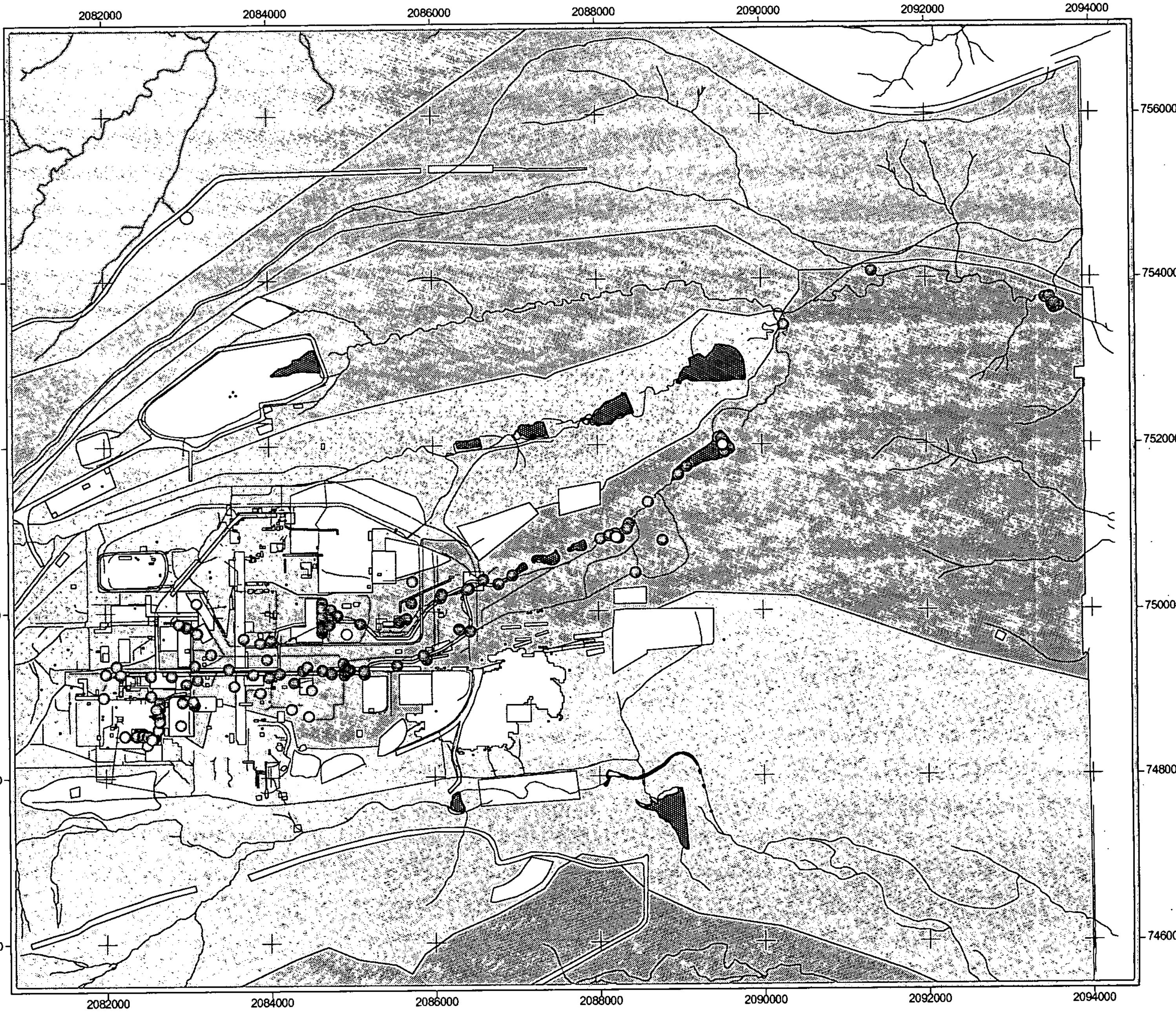

Figure B-9
South Walnut Creek AEU
Sediment Sampling Locations for Barium

KEY

Sampling location

- Moderate potential (>toxicity threshold = 287 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>189 and <287 mg/kg)
- Low potential (<ESL = 189 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
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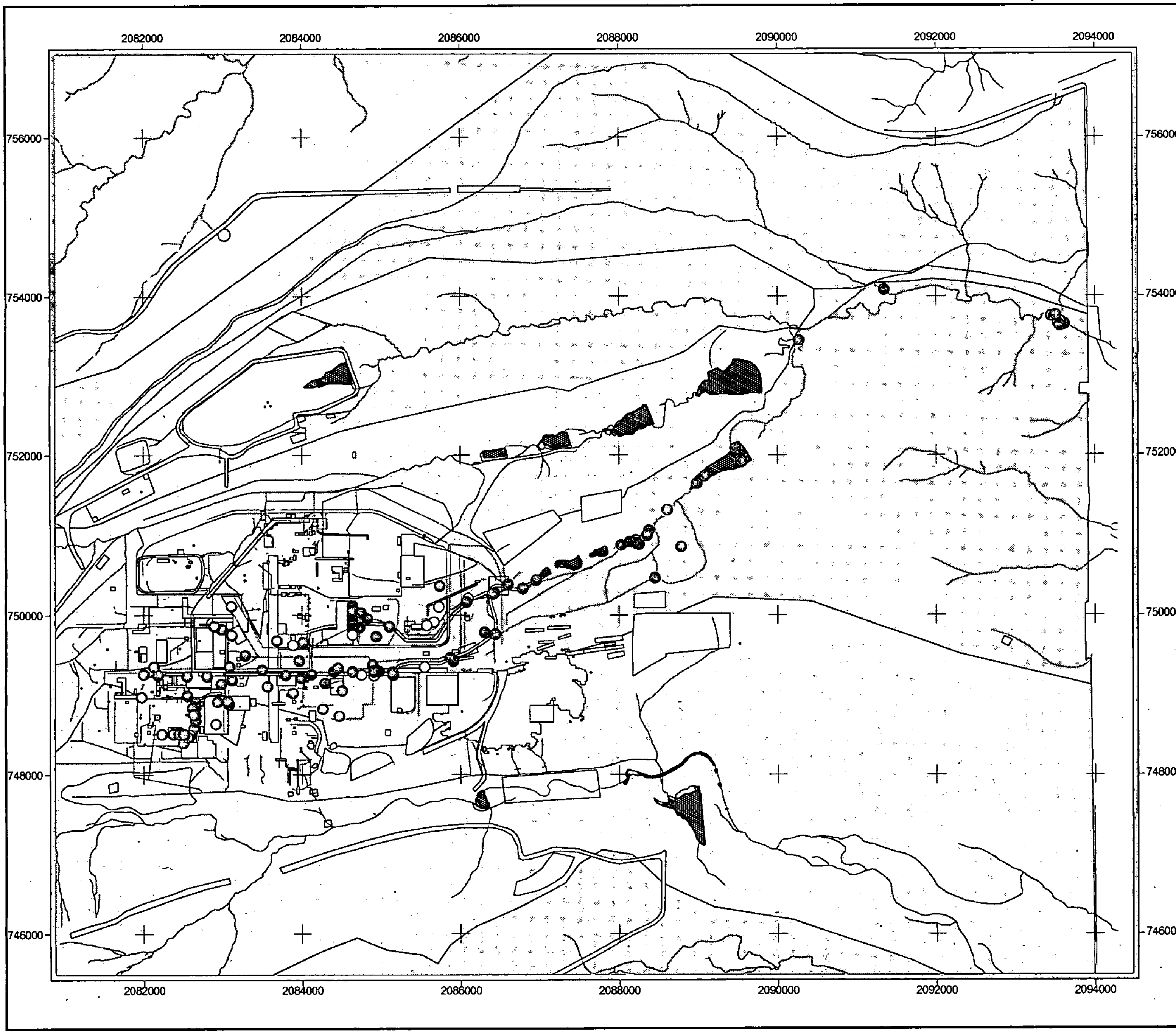

Figure B-10
South Walnut Creek AEU
Sediment Sampling Locations for
Chromium

KEY

Sampling location

- Moderate potential (>toxicity threshold = 111 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>43.4 and <111 mg/kg)
- Low potential (<ESL = 43.4 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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700 0 700 1400 Feet

Scale 1:22,000

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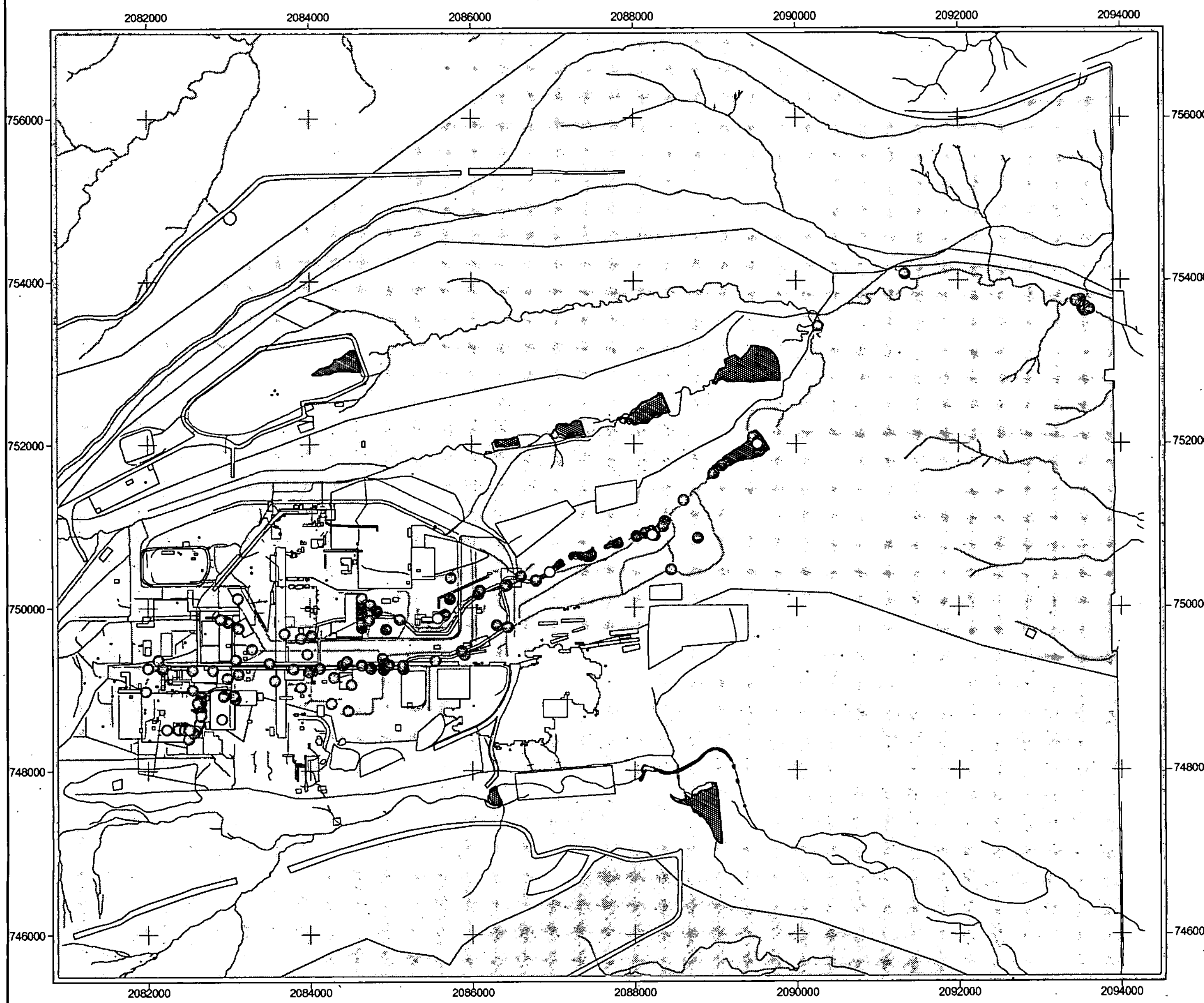

Figure B-11
South Walnut Creek AEU
Sediment Sampling Locations for
Iron

KEY

Sampling location

- Moderate potential (>toxicity threshold = 280,000 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>2,000 and <280,000 mg/kg)
- Low potential (<ESL = 2,000 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N
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700 0 700 1400 Feet

Scale 1: 22,000

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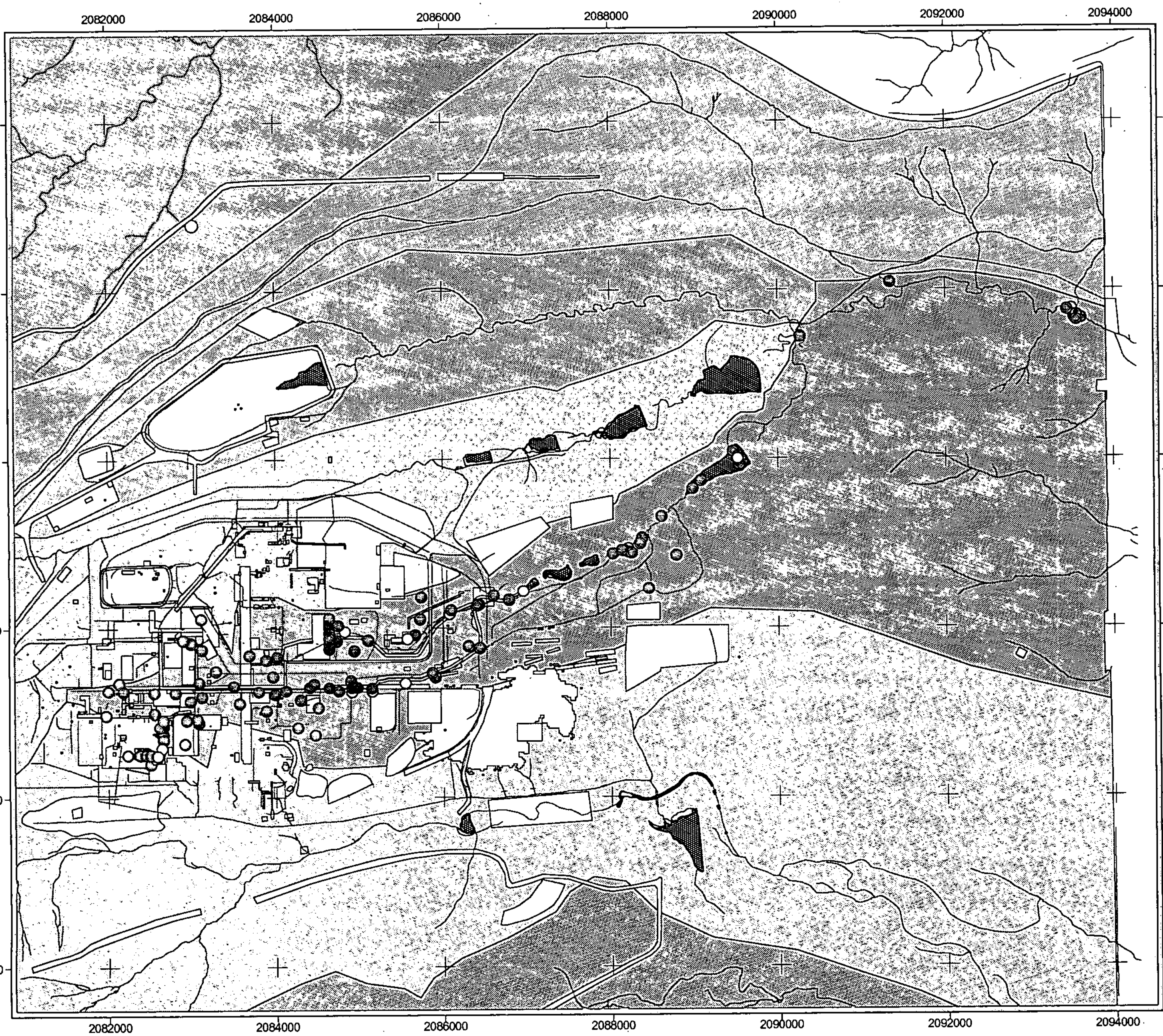

Figure B-12
South Walnut Creek AEU
Sediment Sampling Locations for Nickel

KEY

Sampling location

- Moderate potential (>toxicity threshold = 48.6 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>22.7 and <48.6 mg/kg)
- Low potential (<ESL = 22.7 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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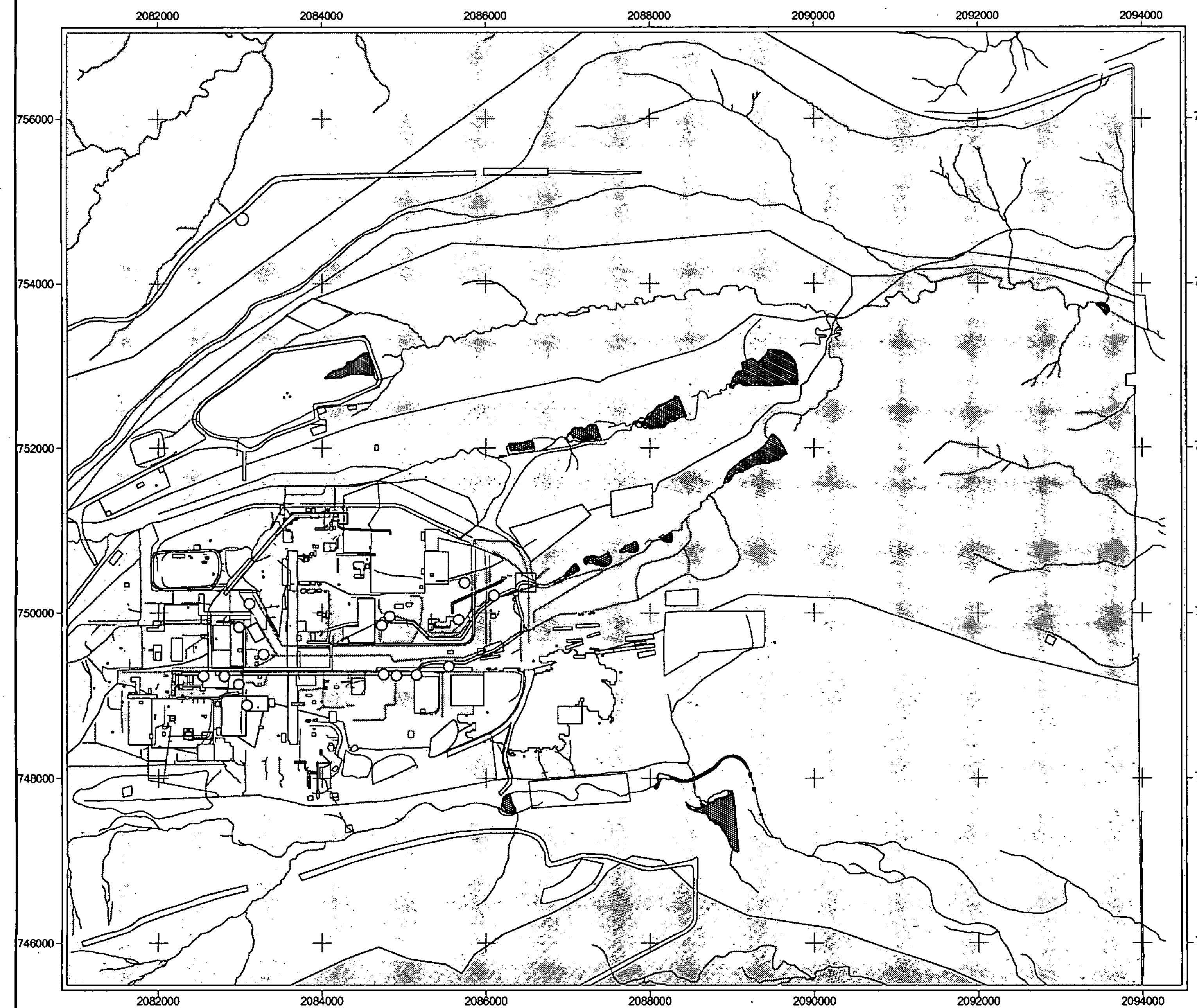

Figure B-13
South Walnut Creek AEU
Sediment Sampling Locations for Fluoride

KEY

Sampling location
- Moderate potential (>toxicity threshold = 7 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>0.01 and <7 mg/kg)
- Low potential (<ESL = 0.01 mg/kg)
- Nondetect

- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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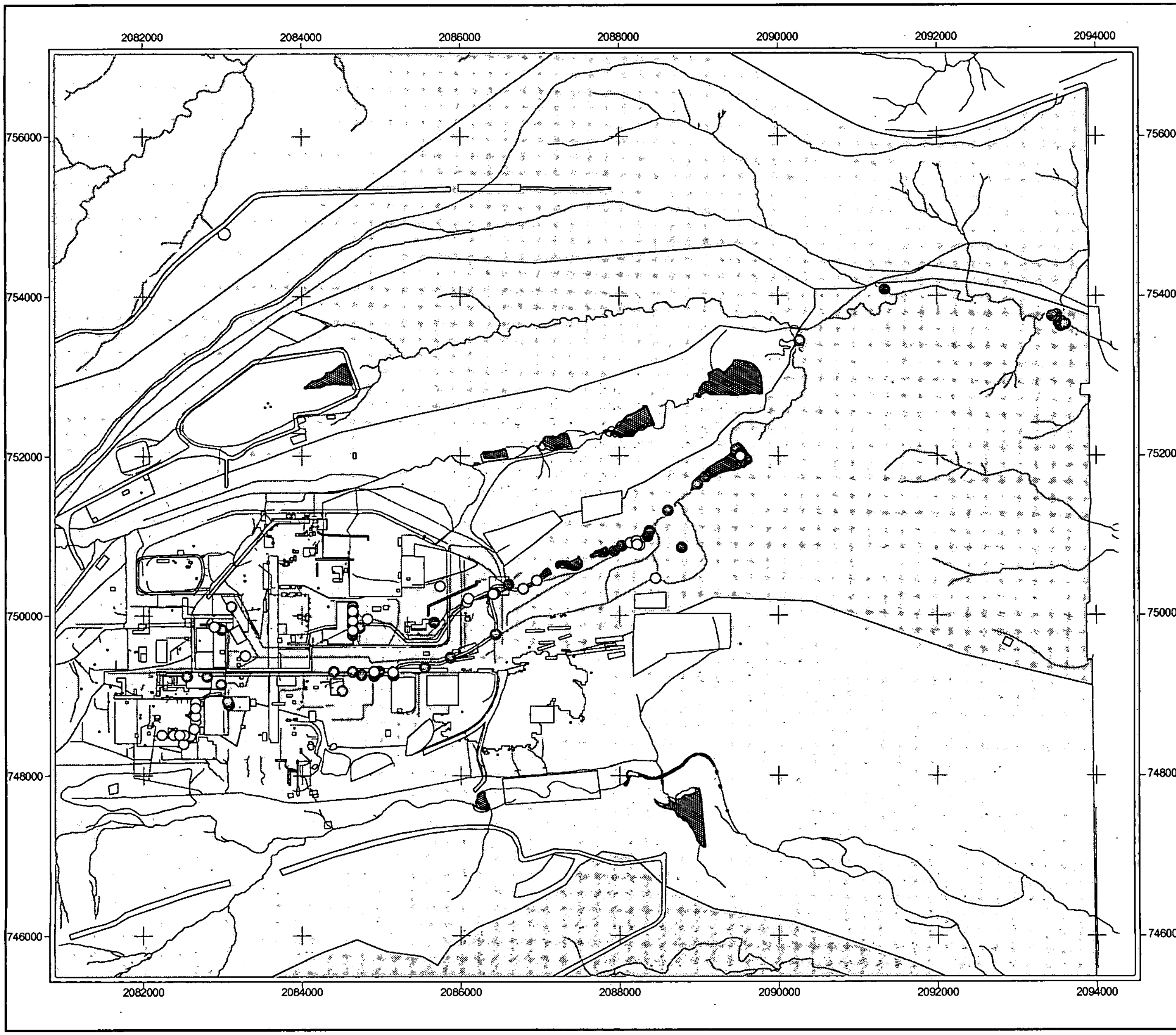
Figure B-14
South Walnut Creek AEU Sediment Sampling Locations for Zinc



KEY

Sampling location

- Moderate potential (>toxicity threshold = 459 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>121 and <459 mg/kg)
- Low potential (<ESL = 121 mg/kg)
- Nondetect

- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000

State Plane Coordinate Projection
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Figure B-15
South Walnut Creek AEU
Sediment Sampling Locations for
Acenaphthene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,300 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>6.71 and <1,300 ug/kg)
- Low potential (<ESL = 6.71 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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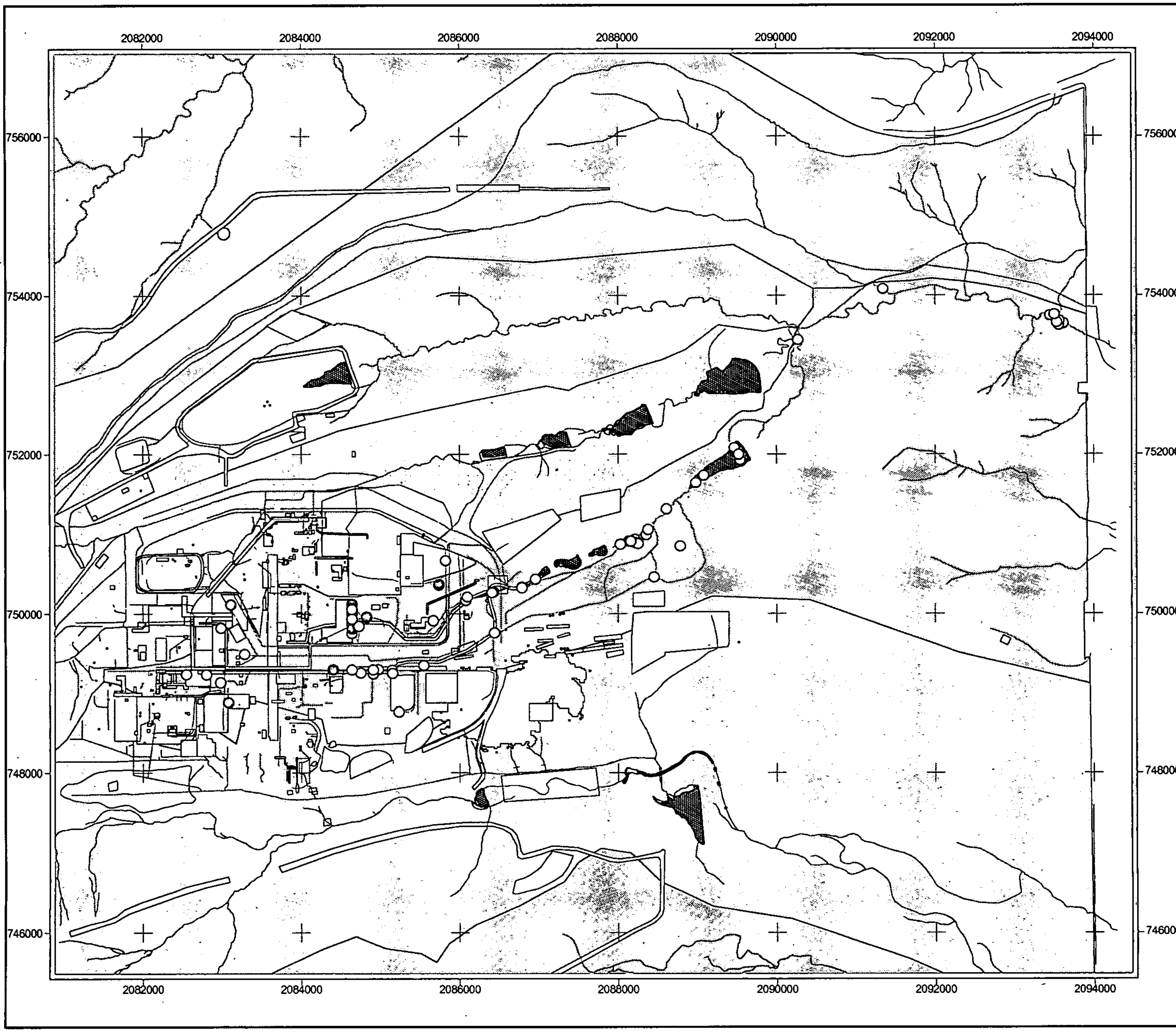
Figure B-16
South Walnut Creek AEU
Sediment Sampling Locations for Anthracene



KEY

Sampling location

- Moderate potential (>toxicity threshold = 845 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>57.2 and <845 ug/kg)
- Low potential (<ESL = 57.2 ug/kg)
- Nondetect

Stream

Lake or Pond

PAC

IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N S E W

700 0 700 1400 Feet

Scale 1: 22,000

State Plane Coordinate Projection
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Datum: NAD 27

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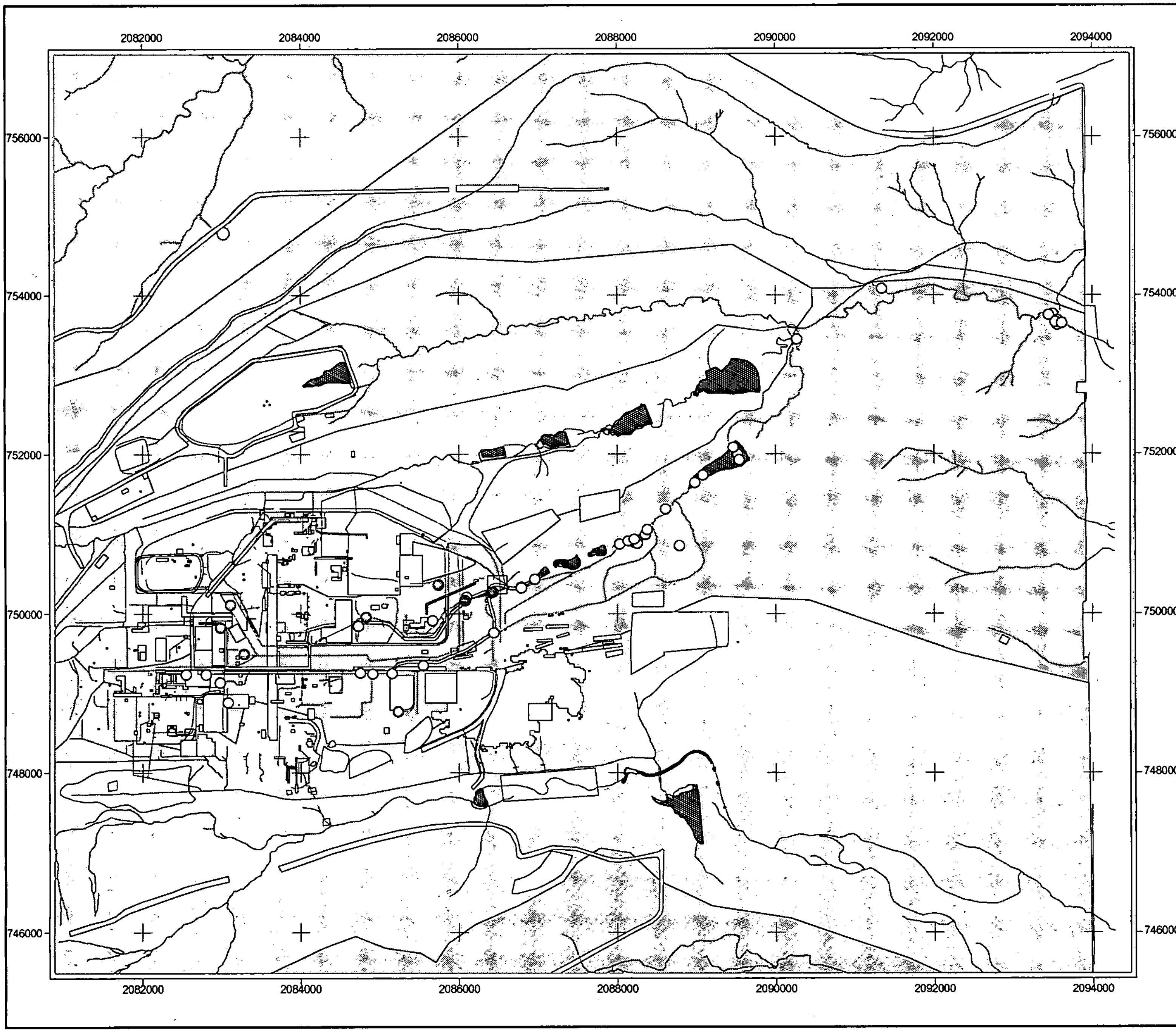


Figure B-17
South Walnut Creek AEU
Sediment Sampling Locations for
Benzo(a)anthracene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,050 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>108 and <1,050 ug/kg)
- Low potential (<ESL = 108 ug/kg)
- Nondetect

Stream

Lake or Pond

PAC

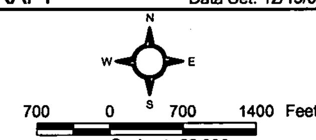
IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04



Scale 1: 22,000
State Plane Coordinate Projection
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Datum: NAD 27

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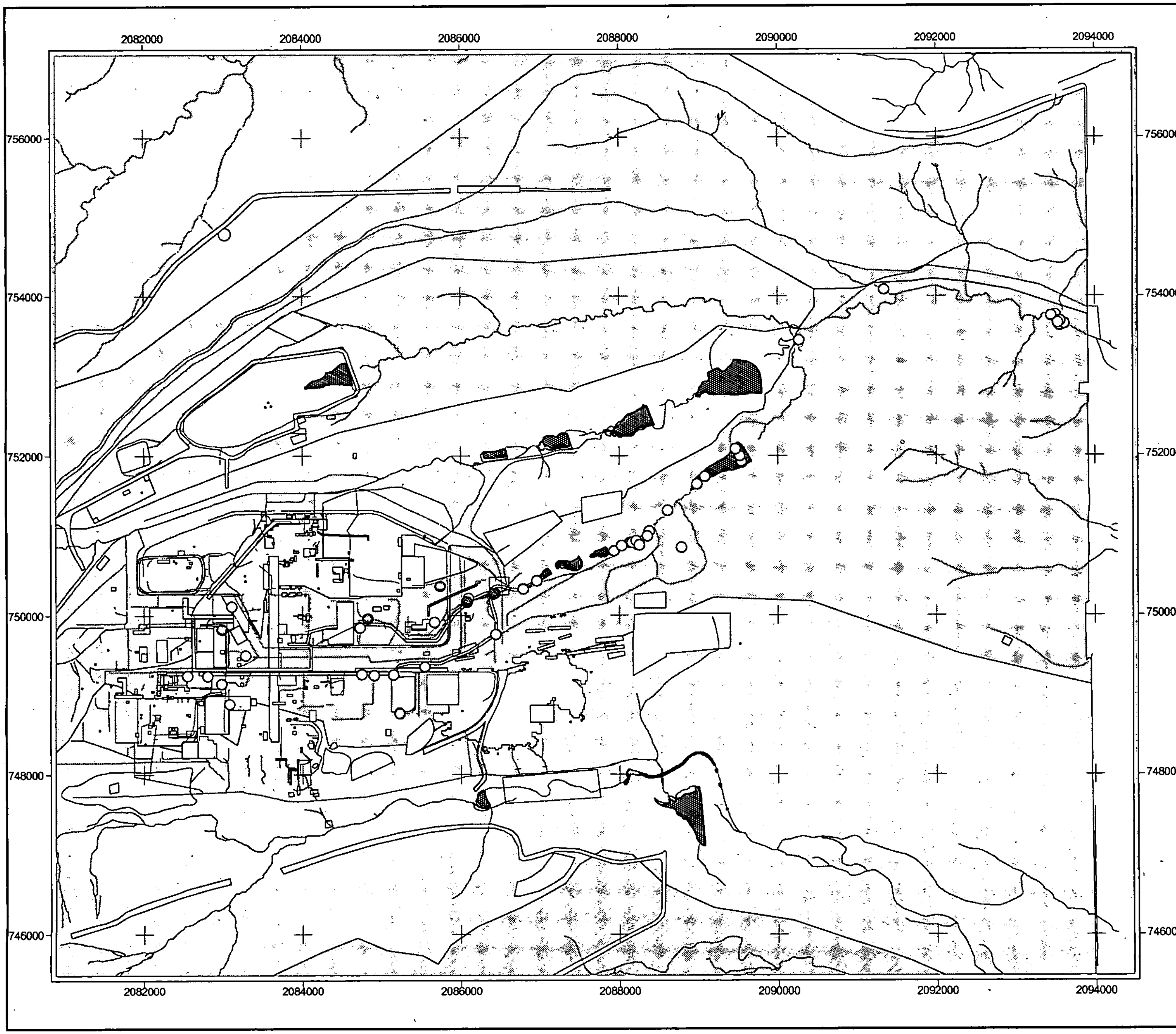

Figure B-18
South Walnut Creek AEU
Sediment Sampling Locations for
Benzo(a)pyrene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,450 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>150 and <1,450 ug/kg)
- Low potential (<ESL = 150 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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700 0 700 1400 Feet

Scale 1: 22,000

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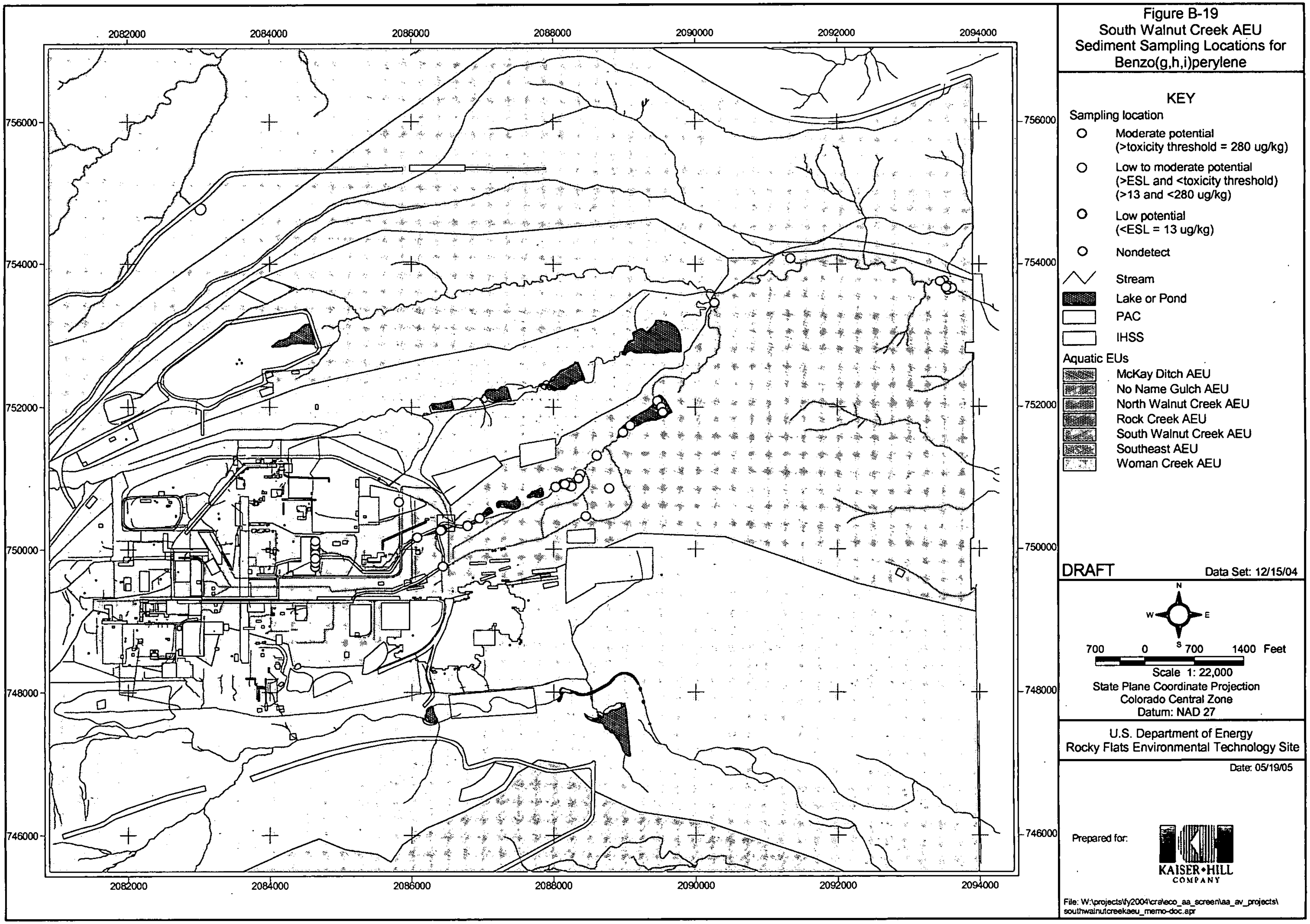

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2084000
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2088000
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2094000
756000
754000
752000
750000
748000
746000
Figure B-19
South Walnut Creek AEU
Sediment Sampling Locations for
Benzo(g,h,i)perylene
KEY
Sampling location
Moderate potential
(>toxicity threshold = 280 ug/kg)
Low to moderate potential
(>ESL and <toxicity threshold)
(>13 and <280 ug/kg)
Low potential
(<ESL = 13 ug/kg)
Nondetect
Stream
Lake or Pond
PAC
IHSS
Aquatic EUs
McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU
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State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27
U.S. Department of Energy
Rocky Flats Environmental Technology Site
Date: 05/19/05
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COMPANY
File: W:\projects\fy2004\cra\eco_aa_screen\aa_av_projects\southwalnutcreekaeu_memo-doc.apr

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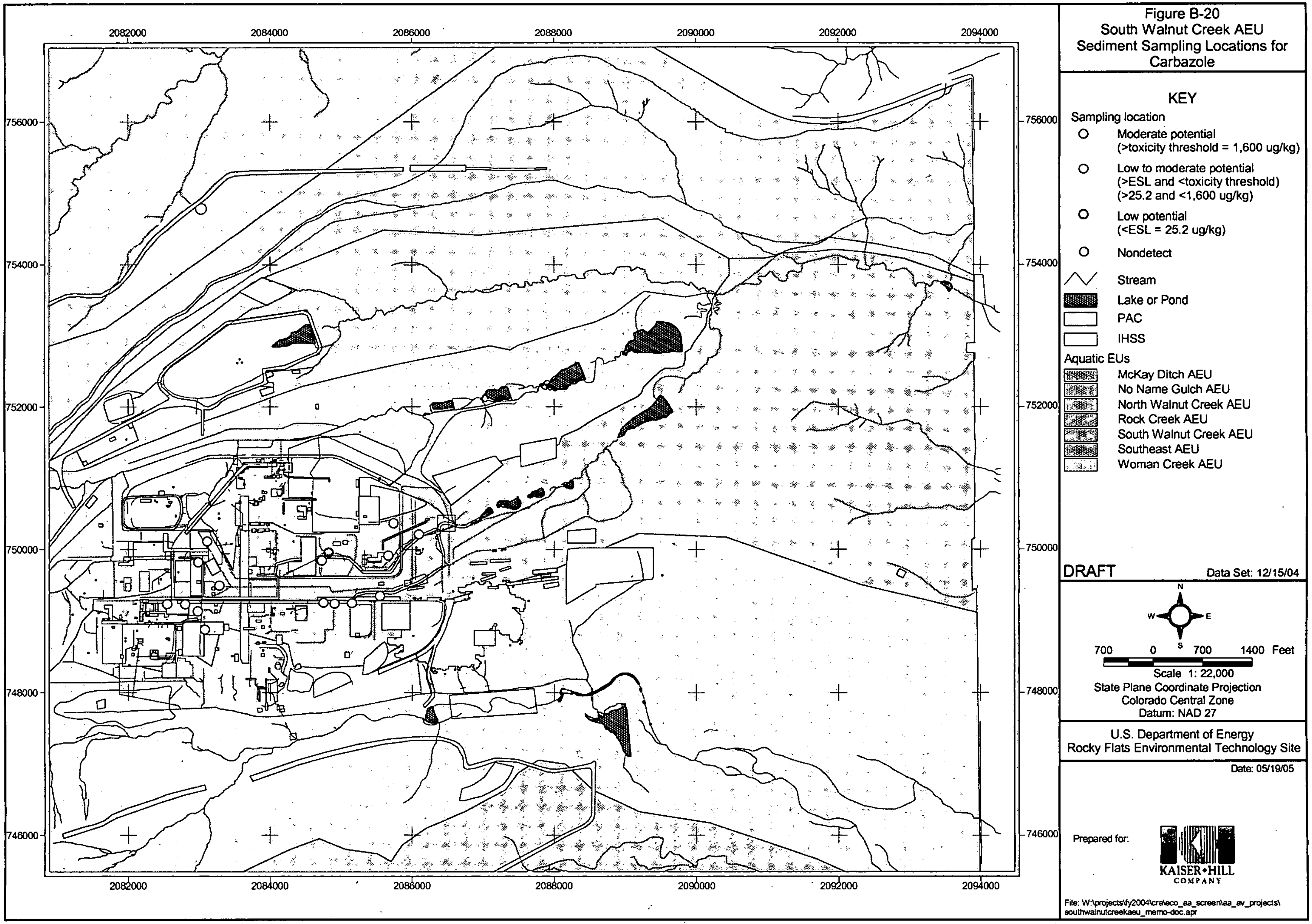

Figure B-20
South Walnut Creek AEU
Sediment Sampling Locations for
Carbazole
KEY
Sampling location
Moderate potential
(>toxicity threshold = 1,600 ug/kg)
Low to moderate potential
(>ESL and <toxicity threshold)
(>25.2 and <1,600 ug/kg)
Low potential
(<ESL = 25.2 ug/kg)
Nondetect
Stream
Lake or Pond
PAC
IHSS
Aquatic EUs
McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU
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Scale 1: 22,000
State Plane Coordinate Projection
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756000
754000
752000
750000
748000
746000

176

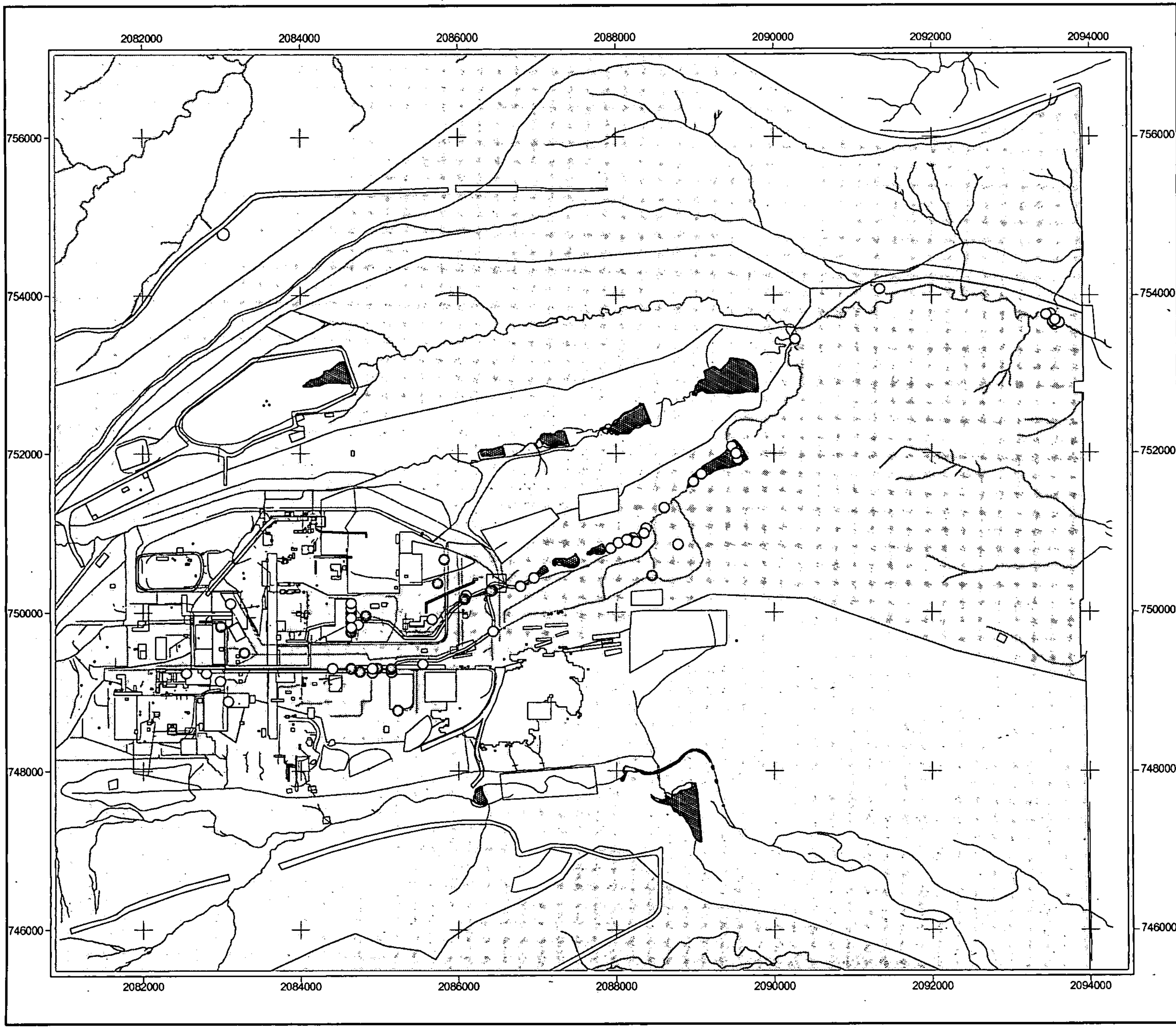

Figure B-21
South Walnut Creek AEU
Sediment Sampling Locations for Chrysene

KEY

Sampling location
- Moderate potential (>toxicity threshold = 1,290 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>166 and <1,290 ug/kg)
- Low potential (<ESL = 166 ug/kg)
- Nondetect

Stream
Lake or Pond
PAC
IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

KAISER•HILL COMPANY

File: W:\projects\fy2004\cra\eco_aa_screen\aa_av_projects\southwalnutcreekaeu_memo-doc.apr

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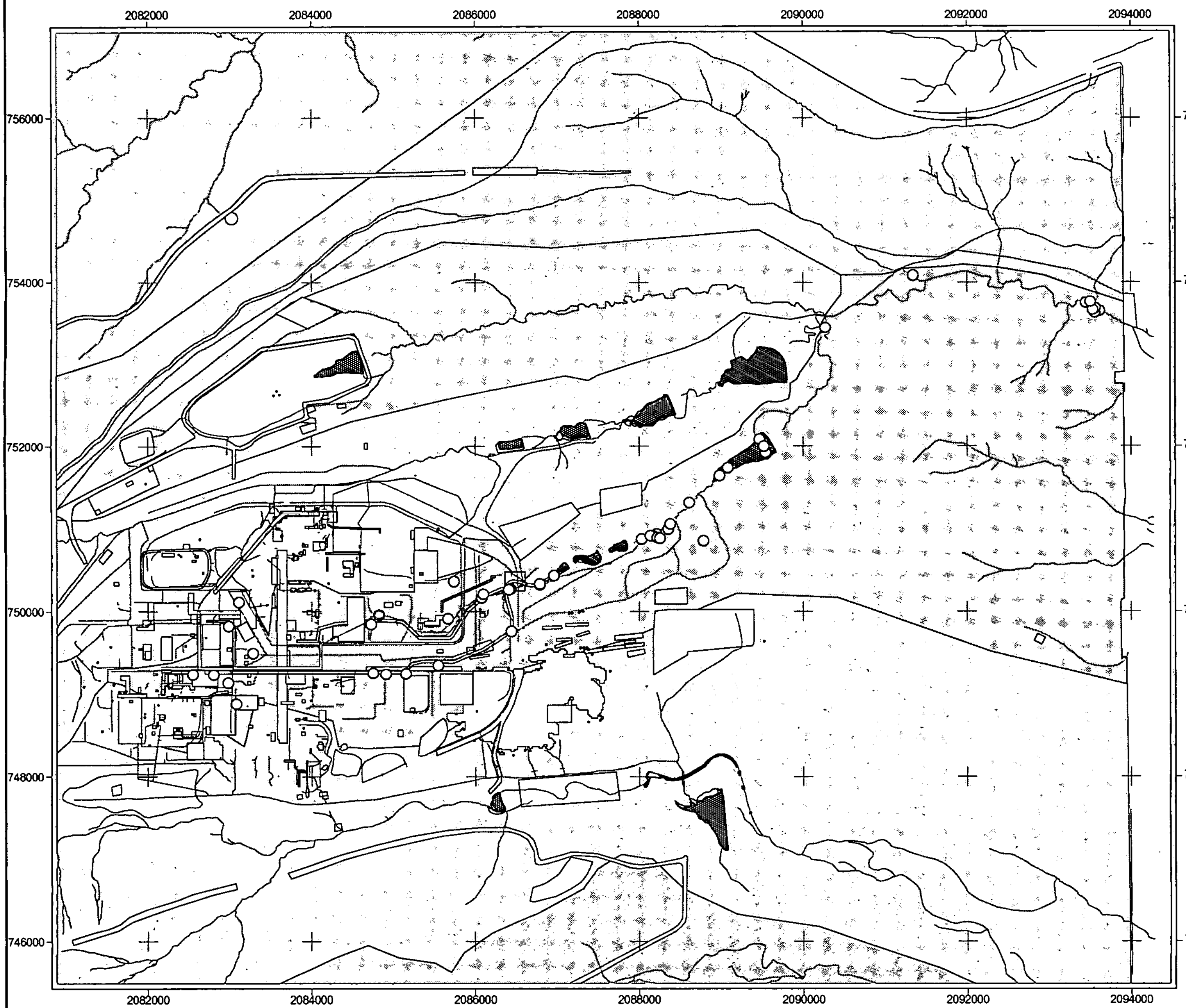

Figure B-22
South Walnut Creek AEU
Sediment Sampling Locations for
Dibenz(a,h)anthracene

KEY

Sampling location
- Moderate potential (>toxicity threshold = 135 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>33 and <135 ug/kg)
- Low potential (<ESL = 33 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

KAISER•HILL COMPANY

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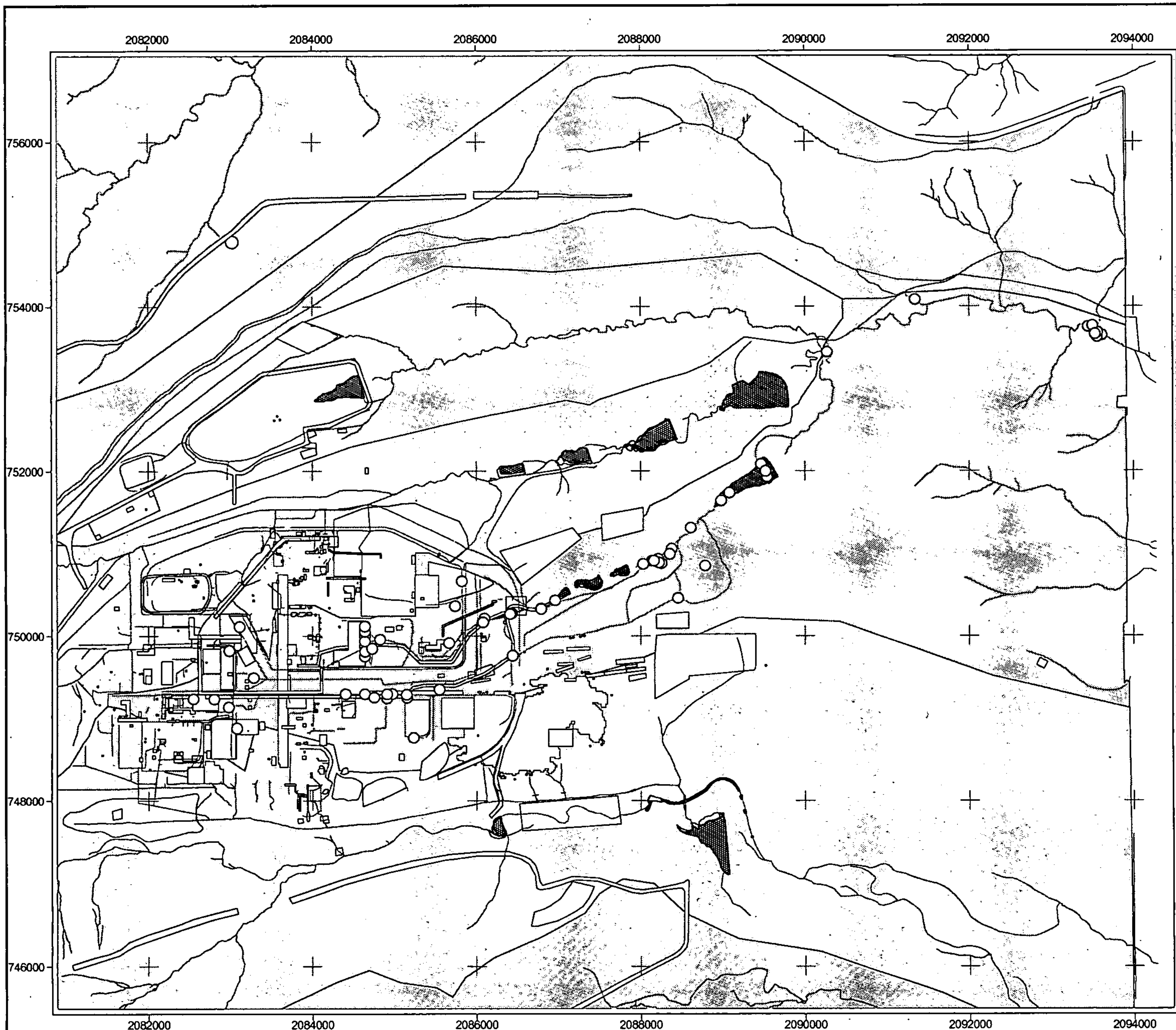

Figure B-23
South Walnut Creek AEU
Sediment Sampling Locations for Fluoranthene

KEY

Sampling location
- Moderate potential (>toxicity threshold = 2,230 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>423 and <2,230 ug/kg)
- Low potential (<ESL = 423 ug/kg)
- Nondetect

- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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Scale 1: 22,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

KAISER•HILL COMPANY

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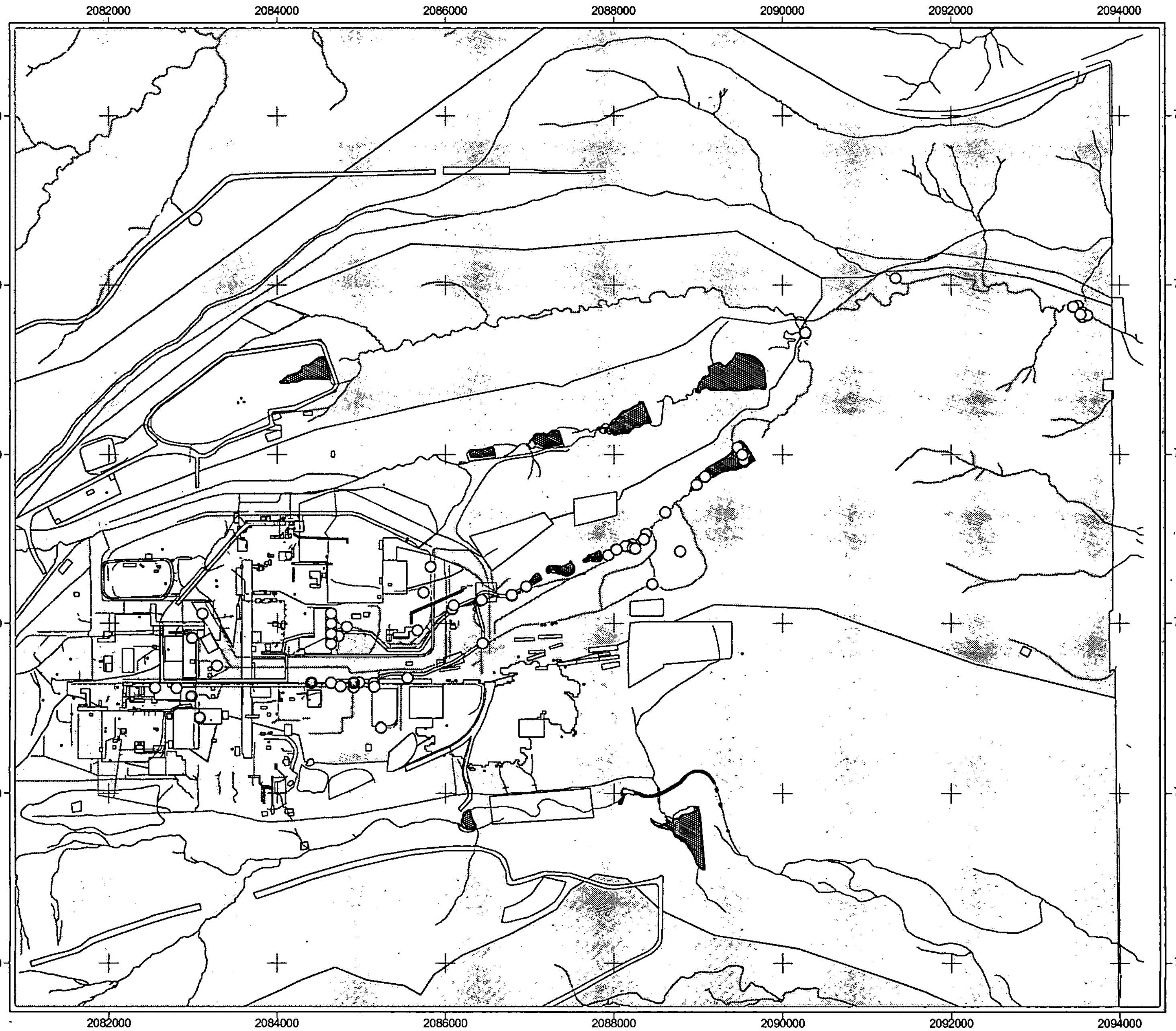

Figure B-24
South Walnut Creek AEU
Sediment Sampling Locations for Fluorene

KEY

Sampling location

- O Moderate potential (>toxicity threshold = 536 ug/kg)
- O Low to moderate potential (>ESL and <toxicity threshold) (>77.4 and <536 ug/kg)
- O Low potential (<ESL = 77.4 ug/kg)
- O Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

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KAISER•HILL COMPANY

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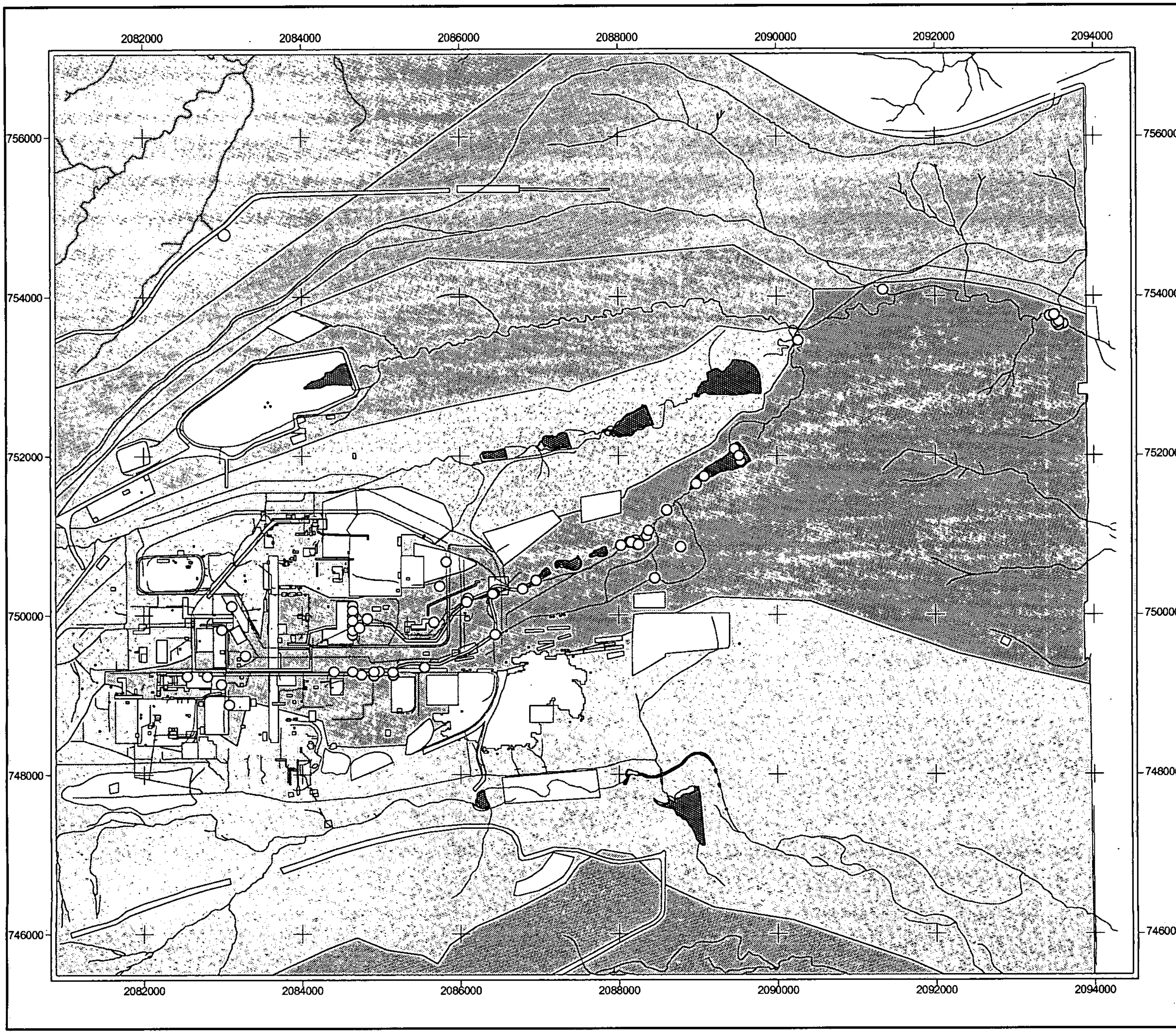

Figure B-25
South Walnut Creek AEU
Sediment Sampling Locations for Indeno(1,2,3-cd)pyrene

KEY

Sampling location
- Moderate potential (>toxicity threshold = 250 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>17 and <250 ug/kg)
- Low potential (<ESL = 17 ug/kg)
- Nondetect

Stream
Lake or Pond
PAC
IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

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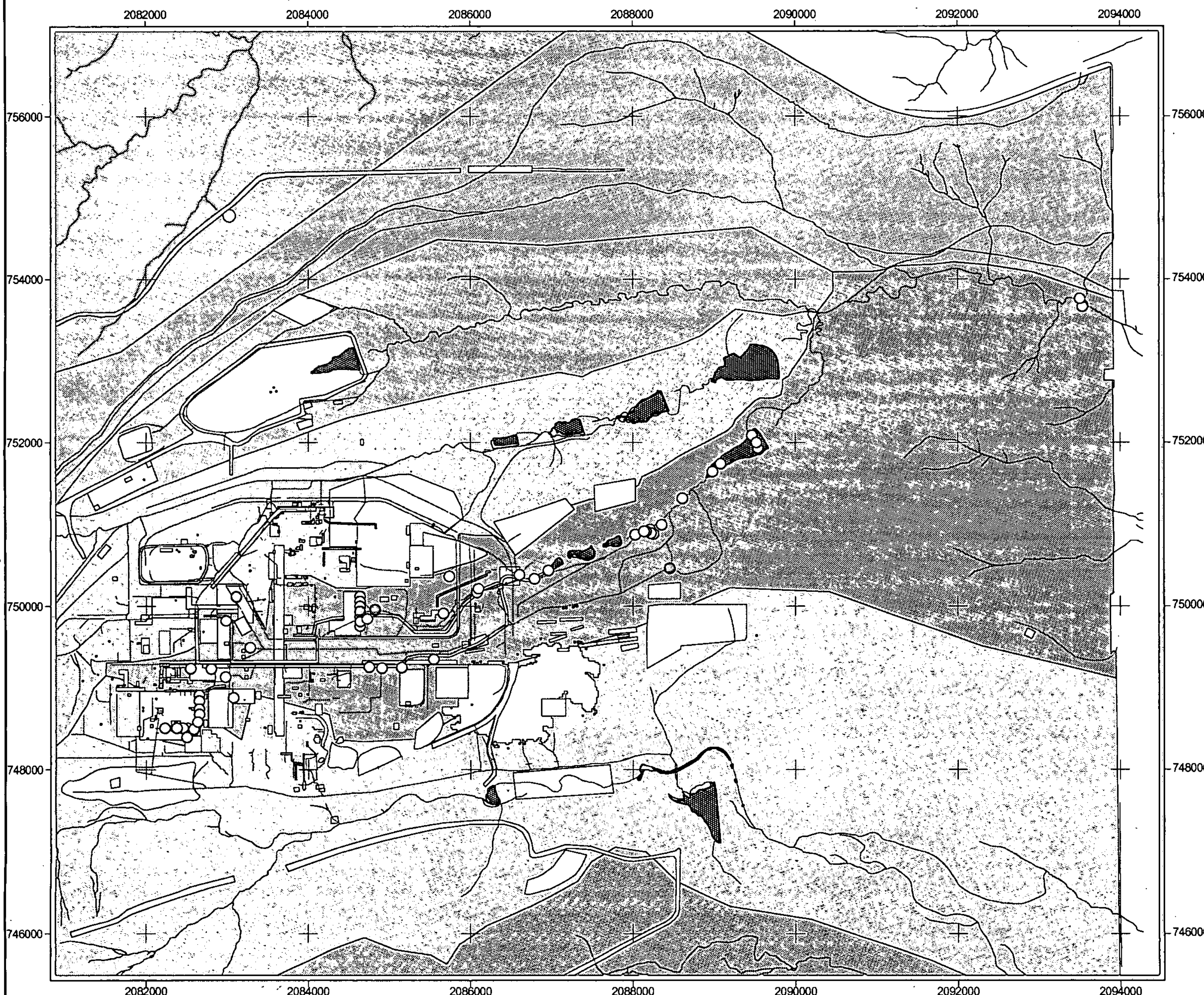

Figure B-26
South Walnut Creek AEU Surface Sediment Sampling Locations for PCB-1254

KEY

Sampling location

- Moderate potential (>toxicity threshold = 300 mg/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>60 and <300 ug/kg)
- Low potential (<ESL = 60 ug/kg)
- Nondetect

Stream

Lake or Pond

PAC

IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

KAISER•HILL
COMPANY

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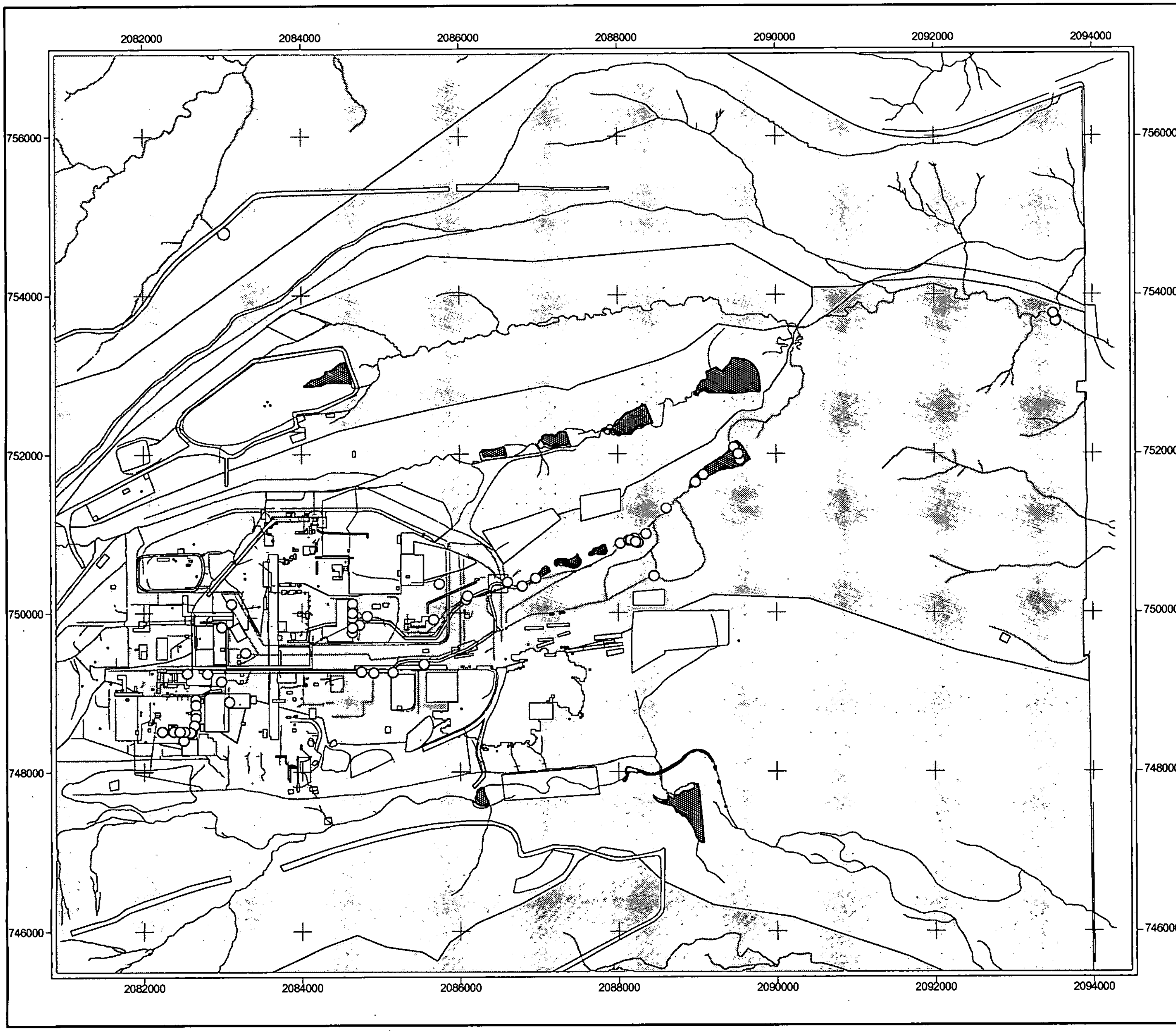

Figure B-27
South Walnut Creek AEU Surface Sediment Sampling Locations for PCB-1260

KEY

Sampling location

- Moderate potential (>toxicity threshold = 200 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>5 and <200 ug/kg)
- Low potential (<ESL = 5 ug/kg)
- Nondetect

Stream

Lake or Pond

PAC

IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

KAISER+HILL COMPANY

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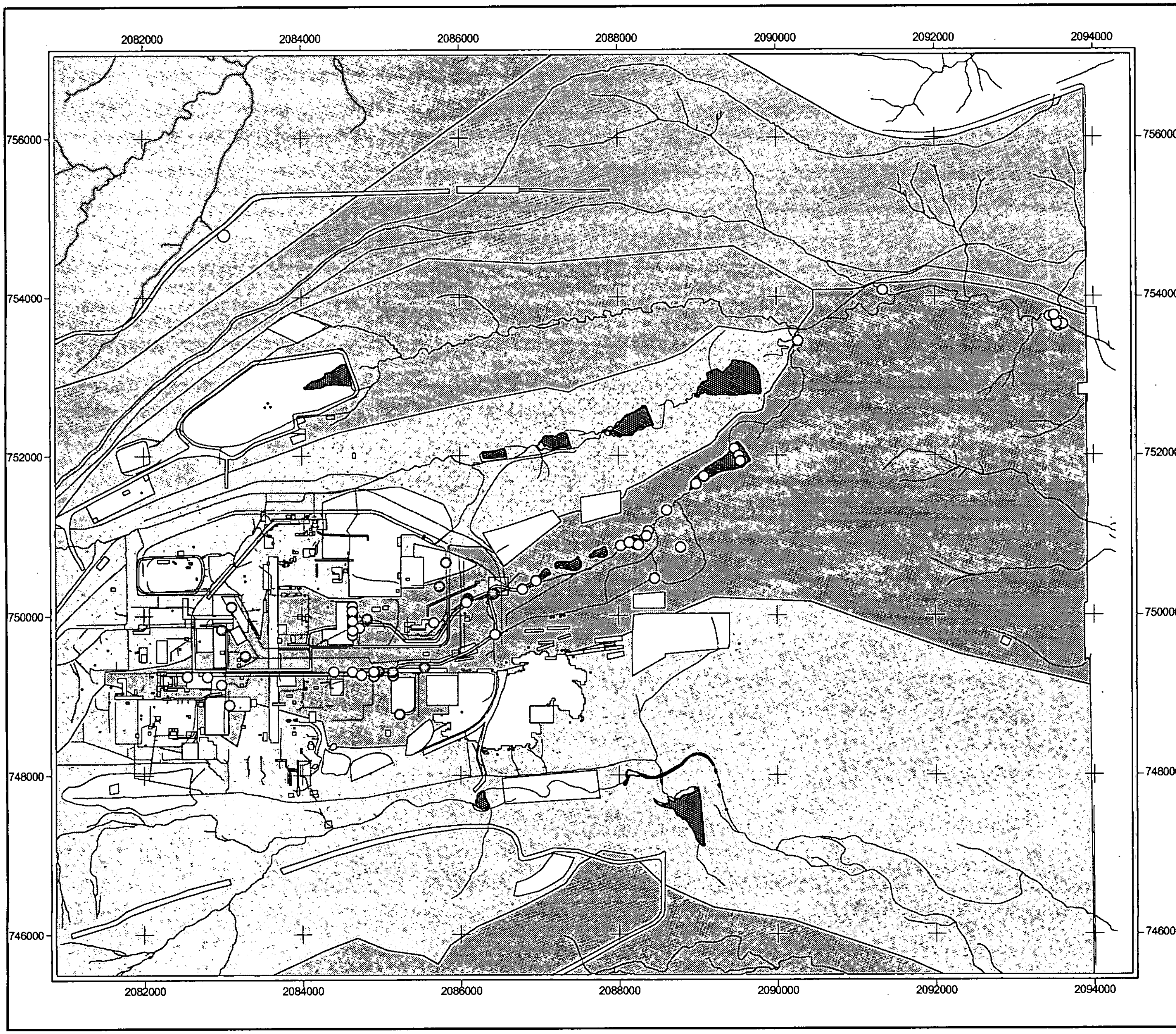

Figure B-28
South Walnut Creek AEU
Sediment Sampling Locations for
Phenanthrene

KEY

Sampling location

O Moderate potential
(>toxicity threshold = 1,170 ug/kg)

O Low to moderate potential
(>ESL and <toxicity threshold)
(>204 and <1,170 ug/kg)

O Low potential
(<ESL = 204 ug/kg)

O Nondetect

Stream

Lake or Pond

PAC

IHSS

Aquatic EUs

McKay Ditch AEU
No Name Gulch AEU
North Walnut Creek AEU
Rock Creek AEU
South Walnut Creek AEU
Southeast AEU
Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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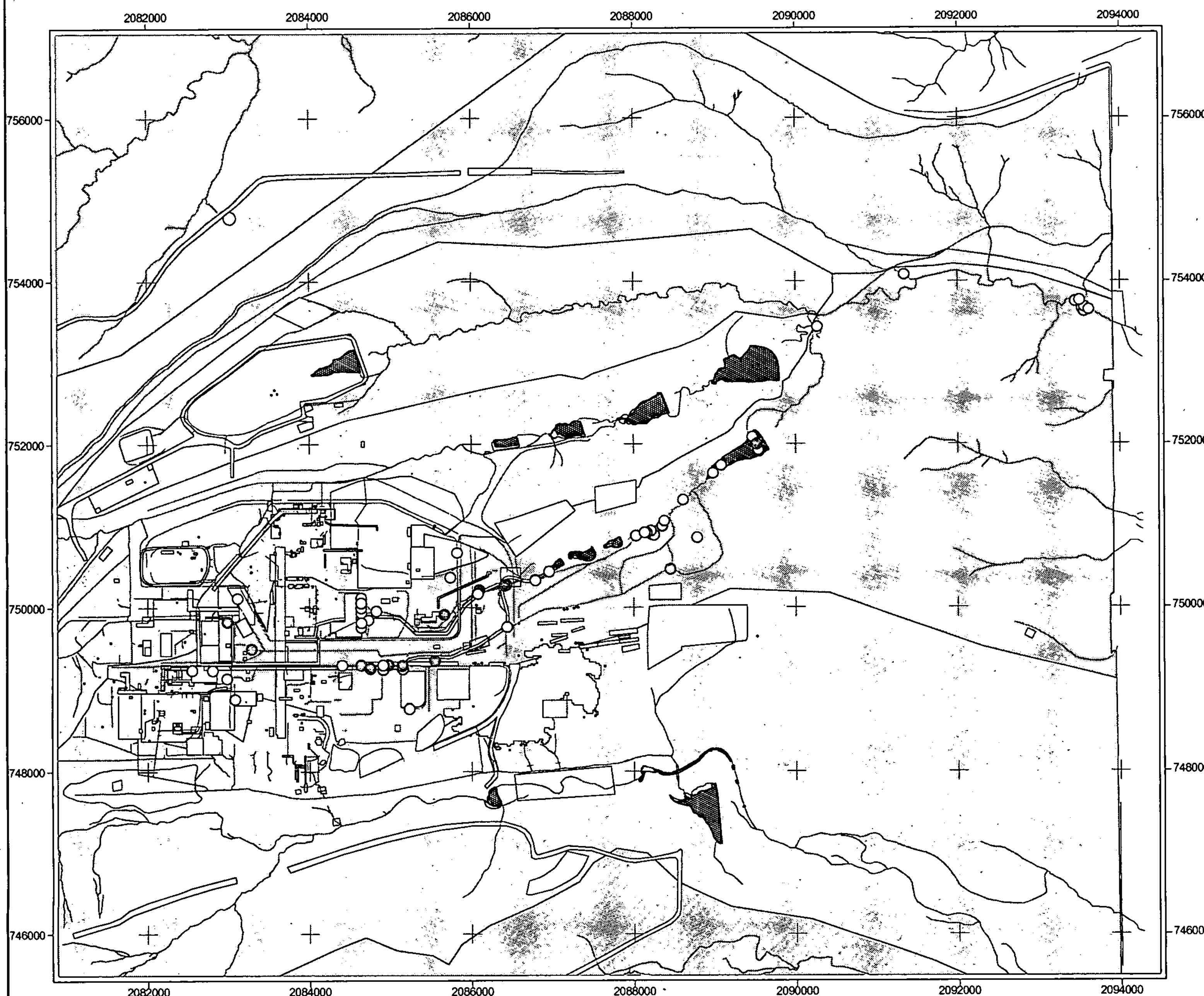

Figure B-29
South Walnut Creek AEU Sediment Sampling Locations for Pyrene

KEY

Sampling location
- Moderate potential (>toxicity threshold = 1,520 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>195 and <1,520 ug/kg)
- Low potential (<ESL = 195 ug/kg)
- Nondetect

- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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700 0 700 1400 Feet

Scale 1: 22,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

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185

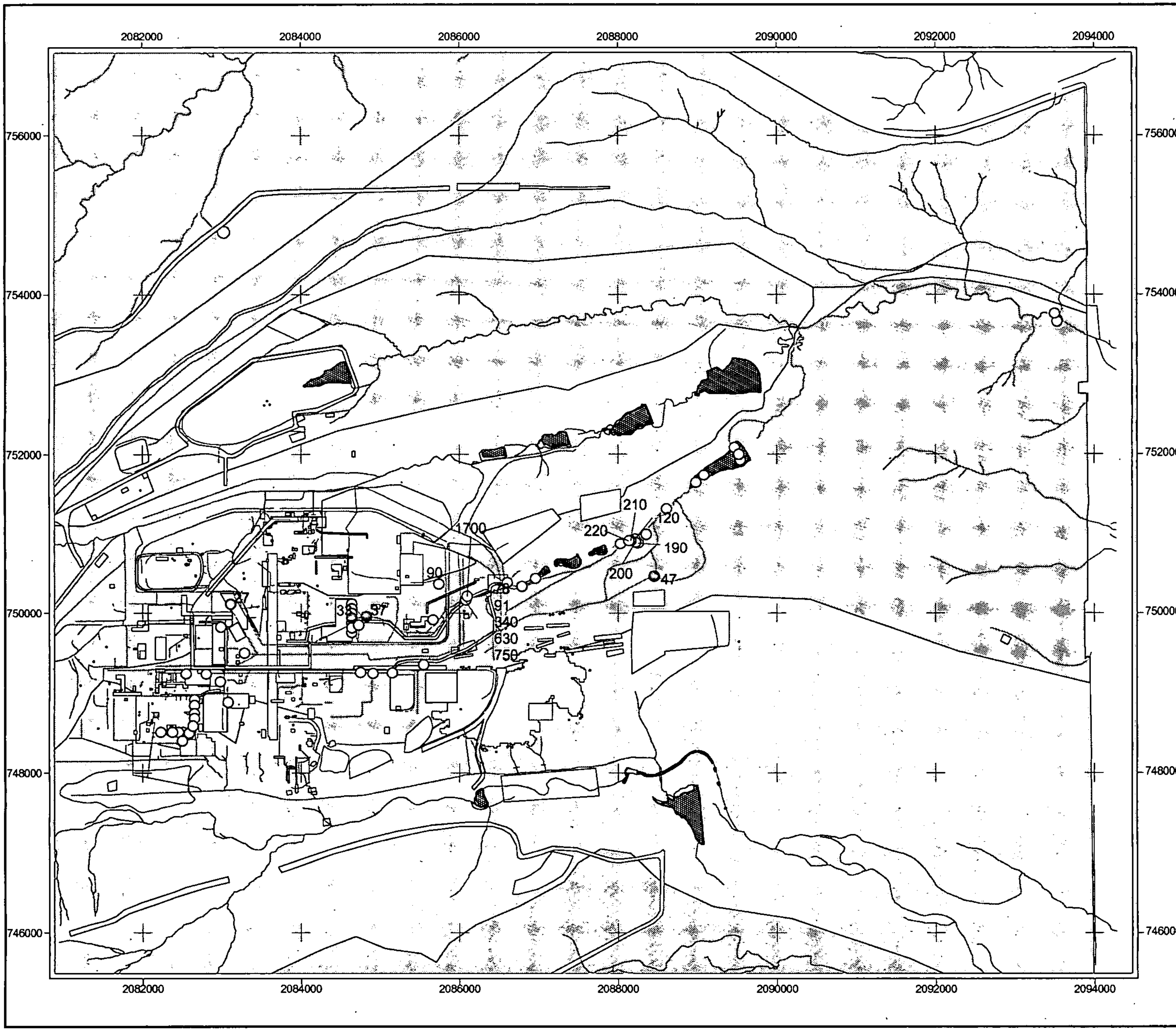

Figure B-30
South Walnut Creek AEU Surface Sediment Sampling Locations for PCB-1254

KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Moderate potential (>toxicity threshold = 300 ug/kg)
- Low to moderate potential (>ESL and <toxicity threshold) (>60 and <300 ug/kg)
- Low potential (<ESL = 60 ug/kg)
- Nondetect
- Stream
- Lake or pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

700 0 700 1400 Feet

Scale 1: 22,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

KAISER•HILL COMPANY

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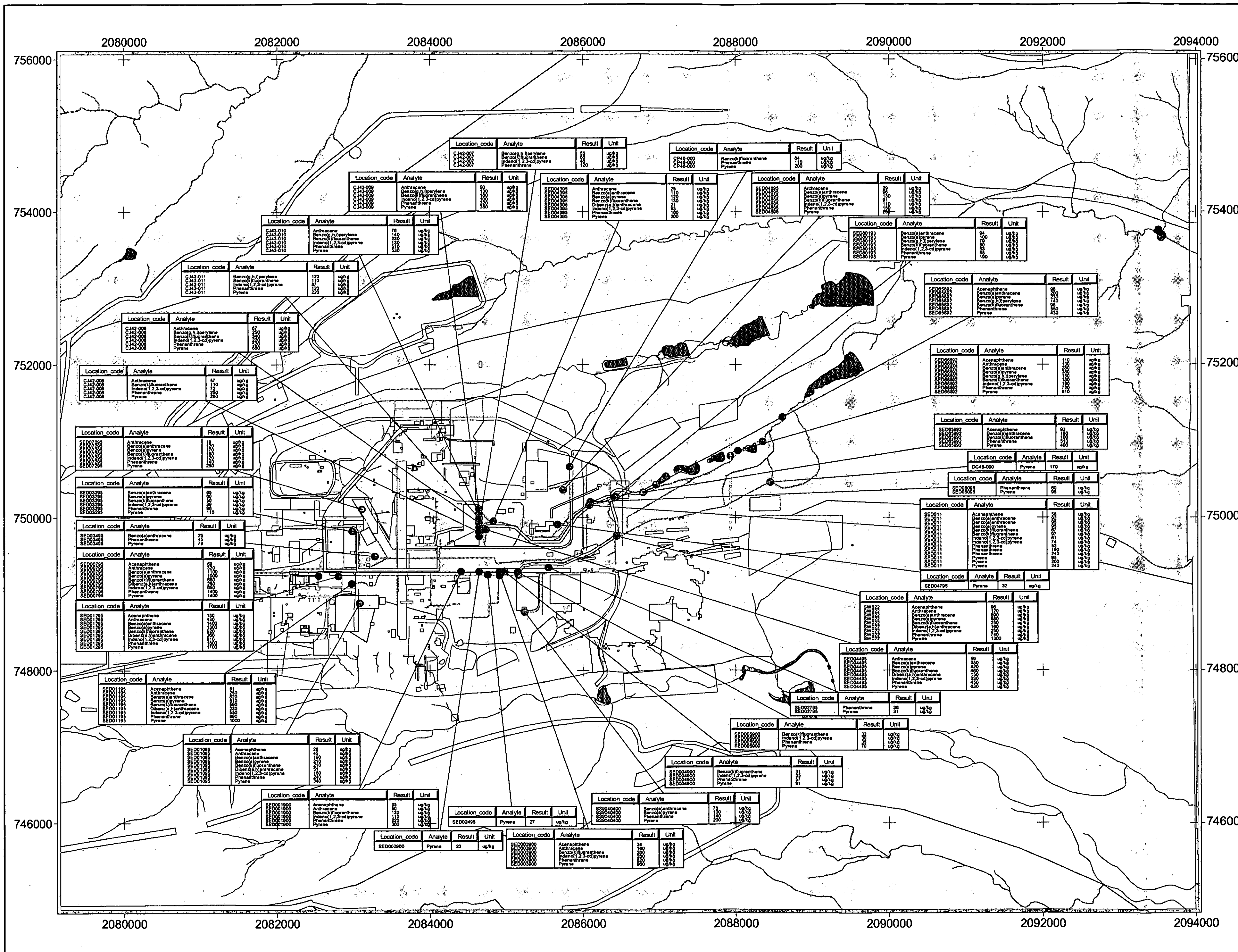

Figure B-31
South Walnut Creek AEU Surface Sediment Sampling Location Results for PAHs

KEY

- Surface sediment sampling location
- Stream
- Lake
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N
W
E
S

700 0 700 1400 Feet

Scale = 1:15,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Date: 05/19/05

Prepared for:

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Attachment 1

Aquatic Ecosystem Health Assessment – South Walnut Creek Aquatic Exposure Unit

187

ACRONYMS

AAI	Aquatic Associates, Inc.
AEU	Aquatic Exposure Unit
DOE	U.S. Department of Energy
ECOPC	ecological contaminant of potential concern
EU	Exposure Unit
HI	hazard index
HQ	hazard quotient
IA	Industrial Area
K-H	Kaiser-Hill Company, L.L.C.
mg/L	milligrams per liter
OU	Operable Unit
PAH	polycyclic aromatic hydrocarbon
PCB	polychlorinated biphenyl
RFCA	Rocky Flats Cleanup Agreement
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
WWE	Wright Water Engineers

AQUATIC ECOSYSTEM HEALTH

The health of aquatic life within South Walnut Creek can be potentially affected by the contaminants associated with Rocky Flats Environmental Technology Site (RFETS) activities that were released into the creek. However, it is important to note that the aquatic environment has been substantially modified by redesign of the drainage and historic management of this Aquatic Exposure Unit (EU) (AEU). This attachment summarizes documented studies that describe the aquatic ecosystem health within South Walnut Creek. This information was obtained from previous investigations and summarized to understand the holistic condition of the drainage.

Baseline Biological Characterization of the Terrestrial and Aquatic Habitats at Rocky Flats Plant (DOE 1992) – A baseline study of terrestrial and aquatic environments at RFETS from 1990 to 1991 was conducted. Of the aquatic ecosystem, streams, impoundments, and wetlands were the major habitats studied. The aquatic habitats were found to have high species richness, an indication of a healthy ecosystem. Four different groups of organisms were studied: phytoplankton, periphyton, benthic macroinvertebrates, and fish.

The report documents that aquatic habitats at RFETS have a very high density of benthic macroinvertebrates. Fish species diversity in the semiarid climate is naturally low, due to the harsh environmental conditions (for example, intermittent streams) and the larger pools and ponds required to support fish populations. Nine species of fish were collected at RFETS, most in the family *Cyprinidae* (minnow family, six species). Most species were found in pools or impoundments that offer refuge from annual drought conditions. Several ponds had very high populations of golden shiners and fathead minnows.

The authors report that the most disruptive environmental factor to aquatic communities at RFETS is the natural semiarid conditions. All streams have sections that are intermittent, while others are fed by groundwater seeps that keep sections perennial. Aquatic communities on RFETS thrive despite the environmental limitations. Many aquatic organisms present are adapted to low-stream flow conditions. These organisms are often classified as "tolerant" considering general water quality.

South Walnut Creek has been modified into a series of retention ponds (the B-series ponds). These retention ponds and connecting stream network provide habitat for plants and animals adapted to the water level fluctuations. Benthic macroinvertebrate samples from Walnut Creek contained 59 taxa during fall sampling. *Diptera* had the highest species richness with 24 species. One species of fish, fathead minnows, were collected from the A-series ponds. No predatory fish were found.

Rocky Flats Cleanup Agreement (RFCA) Facility Investigation/Remedial Investigation (RFI/RI) Report Operable Unit (OU) 3, Appendix K, Polychlorinated Biphenyl (PCB) Study (DOE 1996) – Results from sediment sampling (June-July 1994) reveal no detectable levels of PCBs in the terminal ponds, Ponds A-4, B-5, and C-2. PCB levels in fish tissue collected from the A- and B-Series pond are below effects thresholds for fish-eating birds.

Final Phase I RFI/RI Report for Walnut Creek. Appendix N: Ecological Risk Assessment for Walnut Creek Watershed (DOE 1996) – Initial exposure screens for receptor species and source areas revealed ecological contaminants of potential concern (ECOPC) for more sedentary terrestrial species and aquatic receptors that spend most of their time in small areas (DOE 1996). Radionuclides in sediment did not contribute to ecological risk in the aquatic environment. The tiered screening level hazard assessment of the South Walnut Creek watershed was characterized by hazard indices HIs for the ponds exceeding 100, with the exception of Pond B-5 with an HI of 8.1 and Pond B-1 reaching an HI of 2000.

Risks to aquatic life were primarily due to polycyclic aromatic hydrocarbons (PAHs) in sediments. However, no toxicity was detected in sediment toxicity tests and ecological measures did not correlate with increasing HI values from the ponds. The importance of sediment contamination is unclear but does not appear to be the primary factor controlling benthic community structure in the B-series ponds.

ECOPCs from South Walnut Creek aquatic environments resulted in hazard quotients (HQs) greater than 1 for aquatic-feeding birds, including Aroclor-1254 in A- and B-series pond sediments, and di-n-butylphthalate in A- and B-series pond sediments. Aroclor-1254 concentrations in sediment exceeded risk-based criteria for Ponds B-1, B-2, and B-3 only if the top aquatic predator fish were present. The upper B-series ponds did not support this type of fish community for aquatic-feeding birds to feed upon so the risk was discounted. The authors did indicate that Aroclor-1254 could become a risk if pond management changes. Mercury was detected in 75 percent of the fish in the B-series ponds. However, the risks were low and the magnitude of fish tissue concentrations did not correlate to media concentrations. The authors concluded that mercury and di-n-butyl phthalate did not appear to represent risk to aquatic-feeding birds.

Lower Walnut Creek Aquatic Sampling, Spring 1998 (K-H 1998) – The objectives of this study of lower Walnut Creek were to determine the quality of aquatic habitat, richness, and abundance of benthic macroinvertebrates; identify what fish species are present; determine the condition of the benthic macroinvertebrate and fish populations in lower Walnut Creek; and compare these results to downstream areas (K-H 1998). One site within RFETS was investigated, along with five others located east of the Site. The conclusions indicated aquatic life in Walnut Creek is limited by stream flow, which has been modified from natural flow conditions. However, the assessment presented findings of good habitat and a relatively healthy macroinvertebrate community, which equates to relatively good water quality. The study stated that the water quality is good in Walnut Creek and there are no indications that pollution is limiting aquatic life. The observed species are controlled/affected by the intermittent flows in the creek. The study recognized the limitations of being a single sampling event, and thus a "snap shot" of the creek condition, and recommended that further studies be completed.

Results of the Aquatic Monitoring Program In Big Dry Creek (AAI 1998) – This study summarizes the methods and findings for an aquatic monitoring program initiated in 1997 for Big Dry Creek to understand the ecology (baseline conditions) within the system (AAI 1998). Water quality, benthic macroinvertebrates, and fish were all sampled by Aquatic Associates and the Colorado Division of Wildlife. Findings from the report determined that the physical habitat and fluctuating stream flows most likely limit the macroinvertebrate community in Big Dry Creek, particularly in lower-gradient areas downstream from the Broomfield Treatment Plant where riffle habitats with cobble substrate are sparse and much of the streambed is channelized. The intermittent flows are also a significant controlling factor to the ecology.

Interim Report: Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site 2001-2002 (DOE 2003) – The purpose of this study was to characterize the existing aquatic communities (fish and macroinvertebrates) and physical habitat conditions in the Walnut, Woman, and Rock Creek drainages to provide a baseline for monitoring the potential influences of Site closure activities (DOE 2003). Findings from the study indicated all of the streams at Rocky Flats are flow-limited. Perennial flows are typically in the upper reaches of all three drainages, and flows diminish considerably in downstream reaches where the streams become largely intermittent. In the upper reaches where flows are perennial, habitat assessment scores were generally highest, indicating better overall habitat quality. In the effluent-dominated reach of South Walnut Creek and the discharge-dependent lower section of Walnut Creek, bank erosion resulting in poor bank stability and sediment inputs to the stream is the main problem that negatively affects physical habitat and aquatic life. Stream bank erosion is further aggravated by the periodic discharges from the terminal ponds. Fish abundance and distribution in these streams are severely limited due to the obvious lack of permanent water. A naturally self-sustaining population of fathead minnows was found at site WC3 in South Walnut Creek between Ponds B-4 and B-5.

The macroinvertebrate community was observed as being rich and diverse, and composed mainly of hardy and tolerant species. The dominant organisms found in South Walnut Creek were similar to the other RFETS drainages, with *dipterans* most abundant in Walnut Creek. *Ephemeroptera* were relatively abundant throughout the drainages, and included moderate to tolerant taxa. *Trichoptera* (caddisflies) in Walnut Creek were generally present in higher numbers compared to other RFETS drainages, likely due to the effluent-dominated flows. Amphipods are also found in higher numbers in Walnut Creek in the slower-moving or standing water environments provided by the ponds. Comparing this study's results to other earlier studies of Rocky Flats streams indicated community structure and abundance were somewhat similar to that found in Walnut, Woman, and Rock Creeks during the 2001-2002 study.

Supplemental Biological and Selected Water Quality Data Exploration 1997 – 2001 (WWE 2003) – The purpose of this study was to complete an integrated analysis of habitat, macroinvertebrate, fish, flow, and select water quality parameters on the main stem of Big Dry Creek (WWE 2003). This was completed to develop an understanding of the factors influencing aquatic life in the creek and determine whether a more stringent, un-ionized ammonia standard was necessary to protect the Johnny darter. This evaluation compiled 5 years of biological data. The results indicated effects possibly due to drought conditions. The upstream locations generally have higher-quality fish and benthic communities than downstream. Upstream locations also generally have higher habitat scores, better water quality, and lower flows. Un-ionized ammonia does not appear to be affecting the fish and benthic communities, based on concentrations present in the creek during spring and fall of the last 5 years (range from 0.0 to 0.11 milligrams per liter [mg/L]). Un-ionized ammonia concentrations in the creek are generally below the stream standard.

SUMMARY OF ECOSYSTEM HEALTH

These reports support the conclusion that aquatic habitats in South Walnut Creek are limited by flows which have been modified from natural flow conditions (DOE 1992, K-H 1998, DOE 2003, WWE 2003). These conditions control the habitats and associated aquatic life found in South Walnut Creek. The upper section of South Walnut Creek (containing the ponds) has been highly influenced historically, by the effluent-driven flows and pond maintenance. Ponds B-1 and B-2 typically did not receive effluent flows from the IA under normal operations and only receive water within their small basins during storm events. Effluent from the Industrial Area (IA) was normally carried around the ponds to Pond B-3, although operations and pipeline design provided for diversion to any of the first four ponds depending on the needs of the operators. Given this design, under normal operating conditions these upper ponds tend to have shallow ponds and occasionally become dry or fill with aquatic vegetation creating conditions uninhabitable to aquatic organisms. The lower ponds tend to have perennial habitats and can support more diverse macroinvertebrate communities. The lower portion of Walnut Creek, below Pond B-5, is completely dependent on the batch water releases that create intermittent aquatic condition. All these factors in South Walnut Creek can limit aquatic habitats in this AEU.

Within the aquatic habitats present in South Walnut Creek, whether perennial or intermittent, past studies provide a body of evidence that aquatic communities persist through time and are comparable to other communities found on site and in other areas within the region (DOE 2003). While only one fish species is prevalent (fathead minnow), the manipulated nature of ponds and streams precludes the establishment of viable fish populations. However, macroinvertebrate populations appear not as affected due to their ability to recolonize newly inundated habitats and their comparatively shorter life cycles. Macroinvertebrate communities in Walnut Creek are similar to those found in other RFETS streams. Additionally, recent sampling studies indicate macroinvertebrate communities found at RFETS are similar to other transitional foothills-plains and plains-type streams (DOE 2003). These findings support the conclusions that South Walnut Creek aquatic communities are healthy, albeit limited, and provide normal functions capable of sustaining rich and diverse aquatic life that comprise hardy and tolerant species adapted to the limiting environmental conditions.

REFERENCES

AAI, 1998, Interim Report: Results of the Aquatic Monitoring Program in Big Dry Creek, 1997, Prepared for the Cities of Broomfield, Northglenn, and Westminster, Colorado.

DOE, 1992, Baseline Biological Characterization of the Terrestrial and Aquatic Habitats at Rocky Flats Plant, Golden, Colorado.

DOE, 1996, Final RFCA Facility Investigation/Remedial Investigation Report Operable Unit 3, Appendix K, PCB Study, Rocky Flats Environmental Technology Site, Golden, Colorado.

DOE, 2003, Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, 2001-2002, Golden, Colorado.

K-H, 1998, Final Report: Lower Walnut Creek Aquatic Sampling, Spring 1998, Rocky Flats Environmental Technology Site, Golden, Colorado.

WWE, 2003, Supplemental Biological and Selected Water Quality Data Exploration 1997-2001, Prepared for the Big Dry Creek Watershed Association Steering Committee, April 8.

Attachment 2

Toxicity Thresholds – South Walnut Creek Aquatic Exposure Unit

ACRONYMS

AETA	apparent effect threshold approach sediment quality value, *Hyalella azteca,* dry weight
AEU	Aquatic Exposure Unit
CB-PEC	consensus based-probable effects concentration
COS	classification of sediment as slightly polluted
CRA	Comprehensive Risk Assessment
Crit	criterion, dry weight
ECOPC	ecological contaminant of potential concern
EPA	Environmental Protection Agency
ERL	effect range low
ERM	effect range median
ESL	ecological screening level
ETV	ecotoxicological value, dry weight at 1% organic content
HQ	hazard quotient
LOAEL	lowest observed adverse effect level
MENVIQ/EC	Ministere de l'Environnement du Ques EC
mg/kg	milligrams per kilogram
µg/kg	micrograms per kilogram (may be found as ug/kg)
NIPHEP	National Institute of Public Health and Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
PAH	polycyclic aromatic hydrocarbon
PCB	polycarbonate biphenyl
PEC	probable effect concentration
PEL	probable effect level
SCV	secondary chronic value
SQA	sediment quality advisory level at 1% organic carbon guideline
SQC-MET	sediment quality criterion, minimal effect threshold, dry weight
SQC-TET	sediment quality criterion, toxic effect threshold, dry weight
SQG	sediment quality guideline
TEC	threshold effect concentration
TEL	threshold effect level
TNRCC	Texas Natural Resource Conservation Commission

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TOXICITY THRESHOLDS

A set of toxicity thresholds were selected for each ecological contaminant of potential concern (ECOPC). The sediment ecological screening level (ESLs) from the ECOPC identification process in the Comprehensive Risk Assessment (CRA) Methodology were used in this assessment, along with toxicity thresholds representative of a lowest observed adverse effect level (LOAEL) where available, or similar. Use of these two values for each ECOPC brackets the estimated risk using the hazard quotient (HQ) approach. A description of the thresholds for each ECOPC is provided below. A summary of the thresholds is provided in Table 1.

The endpoints for the sediment thresholds vary. In general, the median observed threshold from available studies was chosen because it represents a conservative, yet appropriate, threshold. Compared to the ranges reported within Table 1, these values represent a central tendency measure. A description of the endpoints, as identified by the investigative study from where they were taken, is provided below.

> <u>MacDonald et al. 2000</u> – Numerical sediment quality guidelines (SQGs) were compiled and evaluated. A set of comparable SQGs were identified for certain inorganic and organic chemicals. For each chemical, two SQGs were identified: (1) a threshold effect concentration (TEC), and (2) a probable effect concentration (PEC). The TECs were determined to provide a value when there was an absence of sediment toxicity, whereas the PECs are values correlating to sediment toxicity. Based on results of the study, the incidence of sediment toxicity was generally low at contaminant concentrations below the TEC, while the PEC defined concentrations above which adverse effects are likely to occur. Because this study represents a culmination of numerous studies with combined endpoints for a suite of chemicals, the PEC was used for the HQ evaluation.
>
> <u>Ingersoll et al. 1996</u> – Sediment effect concentrations were developed for a suite of chemicals based upon laboratory data on the toxicity of contaminants associated with field-collected sediment to the amphipod *Hyalella azteca* and midge *Chironomus riarius*. The sediment effect concentrations are defined as the concentrations of individual contaminants in sediment below which toxicity is rarely observed and above which toxicity is frequently observed. Three types were calculated from the data: (1) effect range low (ERL) and effect range median (ERM), (2) threshold effect level (TEL) and probable effect level (PEL), and (3) no effect concentration. For purposes of this risk characterization, the available ERL or ERM values were used for the HQ evaluation. The ERL represents the chemical concentration below which adverse effects would be rarely observed. The ERL value represents the lower 10th percentile concentration associated with observations of biological effects. According to this method, the concentrations below the ERLs should rarely be associated with adverse effects (EPA 1996). The ERM represents the chemical concentration above which adverse effects would frequently occur.

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Table 1
Toxicity Thresholds for Sediment ECOPCs

ECOPC	Unit	Reported Range of Tox. Thresholds	Selected Toxicity Threshold[a]	Endpoint	Reference
Inorganics					
Aluminum	mg/kg	15900 – 58000	58000	ERM	Ingersoll et al. 1996
Antimony	mg/kg	2 – 500	3.2	SLCA	NYSDEC, 1994
Arsenic	mg/kg	3 – 150	33	CB-PEC	MacDonald et al. 2000
Barium	mg/kg	20 – 500	287	SQG	TNRCC, 1996
Cadmium	mg/kg	0.2 – 30	4.98	CB-PEC	MacDonald et al. 2000
Chromium	mg/kg	6.25 – 600	111	CB-PEC	MacDonald et al. 2000
Cobalt	mg/kg		50	CDM	OMOE, 1987
Copper	mg/kg	8.4 – 840	149	CB-PEC	MacDonald et al. 2000
Fluoride	mg/kg	0.01 – 9.6	7	CT	Bolton et al. 1985
Iron	mg/kg	20000 – 290000	280000	ERM	Ingersoll et al. 1996
Lead	mg/kg	23 – 720	128	CB-PEC	MacDonald et al. 2000
Manganese	mg/kg	300 – 1800	1700	ERM	Ingersoll et al. 1996
Mercury	mg/kg	0.1 – 15	1.06	CB-PEC	MacDonald et al. 2000
Nickel	mg/kg	5 – 100	48.6	CB-PEC	MacDonald et al. 2000
Selenium	mg/kg	5 – 5	5	Crit	Nagpal et al. 1995
Silver	mg/kg	0.5 - 4.5	1.6	SQG	TNRCC, 1996
Zinc	mg/kg	50 – 3200	459	CB-PEC	MacDonald et al. 2000
Organics					
1,2,4-Trimethylbenzene	ug/kg		9200	SQA	EPA 1997
Dichlorobenzene	ug/kg		340	SQA	EPA 1997
Trichlorophenol	ug/kg		340	SQA	EPA 1997
2-Butanone	ug/kg		270	SCV	Jones et al. 1997
2-Methylnaphthalene	ug/kg	20 – 201	201	PEL	Environment Canada, 1999
4-Methylphenol	ug/kg		670	WS-SQS	Ginn and Pastorak, 1992
Acenaphthene	ug/kg	6.71 – 100000	1300	SQA	EPA, 1997
Acenaphthylene	ug/kg	5.87 – 6000	1900	AETA	Cubbage et al. 1997
Aldrin	ug/kg	0.6 – 84	5.3	CT	Bolton et al. 1985
Ammonia	ug/kg	100 – 930	340	AETA	Cubbage et al. 1997
Anthracene	ug/kg	6.8 – 41000	845	CB-PEC	MacDonald et al. 2000
Aroclor-1016	ug/kg	7 – 530	100	SQC-MET	MENVIQ/EC 1992
Aroclor-1242	ug/kg	100 – 100	100	AETA	Cubbage et al. 1997
Aroclor-1248	ug/kg	21 – 5100	50	SQC-MET	MENVIQ/EC 1992
Aroclor-1254	ug/kg	7.3 – 604	60	SQC-TET	MacDonald et al. 2000
Aroclor-1260	ug/kg	5 – 240	5	SQC-TET	MacDonald et al. 2000
Atrazine	ug/kg		0.3	ETV	Stortelder et al. 1989
Benzo(a)anthracene	ug/kg		1050	CB-PEC	MacDonald et al. 2000
Benzo(a)pyrene	ug/kg	9.6 – 450000	470	CB-PEC	Ingersoll et al. 1996
Benzo(b,k)fluoranthene	ug/kg	27 – 37	37	ERM	Ingersoll et al. 1996
Benzo(g,h,i)perylene	ug/kg	10.4 – 21000	280	ERM	Ingersoll et al. 1996
Benzo(k)fluoranthene	ug/kg	2.6 – 1250000	750	COS	NIPHEP, 1989
Benzofluoranthene	ug/kg	300 – 34000	2000	AETA	Cubbage et al. 1997
Benzyl Alcohol	ug/kg		57	SQA	Ginn and Pastorak, 1992

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ECOPC	Unit	Reported Range of Tox. Thresholds	Selected Toxicity Threshold[a]	Endpoint	Reference
Bis(2-ethylhexyl)phthalate	ug/kg	19.95 – 1197	640	AETA	Ingersoll et al. 1996
Butyl benzylphthalate	ug/kg	11000 – 500000	11000	SQA	EPA, 1997
Carbazole	ug/kg	140 -1800	1600	AETA	Cubbage et al. 1997
Chlordane	ug/kg	0.3 – 60	17.60	CB-PEC	MacDonald et al. 2000
Chloroform	ug/kg	0.4 – 0.4	0.4	ETV	Stortelder et al. 1989
Chrysene	ug/kg	8.6 – 11500	1290	CB-PEC	MacDonald et al. 2000
DDD	ug/kg	4 – 60	28.00	CB-PEC	MacDonald et al. 2000
DDE	ug/kg	1 – 190	31.30	CB-PEC	MacDonald et al. 2000
DDT	ug/kg	6 – 11000	62.90	CB-PEC	MacDonald et al. 2000
Dibenz(a,h)anthracene	ug/kg	5 – 3500	230	AETA	Ingersoll et al. 1996
Dibenzofuran	ug/kg	2000 – 32000	24000	AETA	Ingersoll et al. 1996
Dichlorobenzene	ug/kg	32 – 1200	340	SQA	EPA, 1997
Dichlorofluoromethane	ug/kg		52.56	SQA	EPA 1997
Dieldrin	ug/kg	0.1 – 910	61.80	CB-PEC	MacDonald et al. 2000
Di-n-butylphthalate	ug/kg		42	AETA	Ingersoll et al. 1996
Endrin	ug/kg		207.00	CB-PEC	MacDonald et al. 2000
Ethylbenzene	ug/kg	96 – 4800	4800	SQA	EPA, 1997
Fluoranthene	ug/kg	20 – 130000	2230	CB-PEC	MacDonald et al. 2000
Fluorene	ug/kg		536	CB-PEC	MacDonald et al. 2000
Heptachlor epoxide	ug/kg		16.00	CB-PEC	MacDonald et al. 2000
Indeno(1,2,3-cd)pyrene	ug/kg	10.4 – 6000000	250	ERM	Ingersoll et al. 1996
Lindane	ug/kg		4.99	CB-PEC	MacDonald et al. 2000
Methylene chloride	ug/kg	500 – 500	500	CT	Bolton et al. 1985
Naphthalene	ug/kg	10 – 140000	561	CB-PEC	MacDonald et al. 2000
Phenanthrene	ug/kg	6.8 – 210000	1170	CB-PEC	MacDonald et al. 2000
Pyrene	ug/kg	7.6 – 85000	1520	CB-PEC	MacDonald et al. 2000
Tetrachloroethane	ug/kg	2.2 – 1600	1600	SQA	EPA, 1997
Total DDTs	ug/kg		572.00	CB-PEC	MacDonald et al. 2000
Total PAHs	ug/kg	200 – 700000	22800.00	CB-PEC	MacDonald et al. 2000
Total PCBs	ug/kg	2.0 – 40000	676.00	CB-PEC	MacDonald et al. 2000

[a] The hierarch of use of the toxicity thresholds was as follows: MacDonald et al. 2000 as a preference; others (EPA 1997, Ingersoll et al. 1996, etc.) have no preference compared to each other. The best available, most appropriate value is reported in this column.

New York State Department of Environmental Conservation (NYSDEC) 1994 – The value for antimony was derived from this study and represents the criterion; lowest effect level in dry weight.

Texas Natural Resource Conservation Commission (TNRCC) 1996 – The value for barium was derived from this study and represents the SQG of 85th percentile level in reservoirs, dry weight.

Bolton et al. 1985 – The values for Fluoride and Heptachlor were derived from this study. The values represent the chronic equilibrium partition derived threshold at 1% organic carbon.

Ministere de l'Environnement du Ques EC (MENVIQ/EC) 1992 – The value for Aroclor-1254 was derived from this study and represents the sediment quality criterion of toxic effect threshold at 1% organic carbon.

Jones et al. 1997 – This study compilation of available sediment toxicity thresholds and various approaches for their development. The value obtained from this guidance for 4-methylphenol represents the Washington State Sediment Quality Standards for Ionizable Organic Compounds (original source: Ginn and Pastorak 1992). The guidance recommends these values be used cautiously because they are site-specific. The values provide an indication of the magnitude of contamination.

National Institute of Public Health and Environmental Protection (NIPHEP) 1989 – The value for benzo(k)fluoranthene was derived from this study and represents the recommended directive for classification of freshwater and dredged sediments as being slightly polluted.

REFERENCES

Bolton, H.S., R.J. Breteler, B.W. Vigon, J.A. Scanlon, and S.L. Clark, 1985, National Perspective on Sediment Quality, Battelle, Prepared for EPA Contract No. 68-01-6986, Washington Environmental Program Office, Washington, D.C.

Cubbage, J., D. Batts, and S. Breidenbach, 1997, Creation and Analysis of Freshwater Sediment Quality Values in Washington State, Publication No. 97-323a, Washington State Department of Ecology, Olympia, Washington.

Environment Canada, 1999, Canadian Water Quality Guidelines, Guidelines and Standards Division, Hull, Quebec (document obtained from: http://www.ec.gs.ca/ceqg-rcqe/water.htm).

EPA, 1996 as cited within Jones et al. 1997, Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyalella azteca* and the Midge *Chironomus riparius*, EPA 905-R96-008, Great Lakes National Program Office, Chicago, Illinois.

EPA, 1997, The Incidence and Severity of Sediment Contamination in Surface Waters of the U.S.: Volume 1: National Sediment Quality Survey, EPA 823-R-97-006, Office of Science and Technology, Washington, D.C.

Ginn, T.C. and R.A. Pastorak, 1992, Assessment and Management of Contaminated Sediments in Puget Sound. pp. 371-401, in *Sediment Toxicity Assessment*, ed. G.A. Burton, Jr., Lewis Publishers, Boca Raton, Florida.

Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and T.G. Fos, 1996, "Calculation and evaluation of sediment effect concentrations for the amphipod *Hyalella aztca* and the midge *Chironomus riparius*," *Journal of Great Lakes Research* 22(3): 602-623.

Jones, D.S., G.W. Suter II, and R.N. Hull, 1997, Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment Associated Biota: 1997 Revision, ES/ER/TM-95-R4, Prepared for the Office of Environmental Management, U.S. Department of Energy, Washington, D.C.

MacDonald, D.D., C.G. Ingersoll, and T.A. Berger, 2000, "Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems," *Arch. Environ. Cont. and Tox.* 39: 20-31.

MENVIQ/EC 1992, Interim Criteria for Quality Assessment of St. Lawrence River Sediment, ISBN 0-662-19849-2, St. Lawrence Action Plan, St. Lawrence Center and Ministere de l'Environnement du Quebec, Quebec City, Quebec.

Nagpal, N.K., L.W. Pommen, and L.G. Swain, 1995, Approved and Working Criteria for Water Quality, ISBN 0-7726-2522-0, Water Quality Branch. Ministry of Environment, Lands and Parks, Victoria, British Columbia.

NIPHEP, 1989, Recommended Values for the Classification of Freshwater and Dredged Sediments, Bilthoven, Netherlands.

NYSDEC, 1994, Technical Guidance for Screening Contaminated Sediments, Division of Fish and Wildlife, Division of Marine Resources, Albany, New York.

OMOE, 1987, Guidelines for the Management of Dredged Material in Ontario, Toronto, Ontario.

Stortelder, P.B., M.A. van der Gaag, and L.A. van der Kooij, 1989, Perspectives for Water Organisms, An Ecotoxicological Basis for Quality Objectives for Water and Sediment, Part 1, Results and Calculations, DBW/RIZA Memorandum N. 89.01a. (English Version August 1991), Institute for Inland Water Management and Waste Water Treatment, Lelystad, Netherlands.

TNRCC, 1996, The Surface Water Quality Monitoring Program Supplementary Information Manual, Statewide Percentile Report, Water Planning and Assessment Division, Texas Natural Resource Conservation Commission, Austin, Texas.

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APPENDIX C

ECOLOGICAL SCREENING SUMMARY
FOR WOMAN CREEK AQUATIC EXPOSURE UNIT

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ACRONYMS AND ABBREVIATIONS

AEU	Aquatic Exposure Unit
BKG	background
BZ	Buffer Zone
CRA	Comprehensive Risk Assessment
DOE	U.S. Department of Energy
ECOI	ecological contaminant of interest
ECOPC	ecological contaminant of potential concern
EPC	exposure point concentration
ESL	ecological screening level
EU	Exposure Unit
HQ	hazard quotient
IA	Industrial Area
IABZSAP	Industrial Area and Buffer Zone Sampling and Analysis Plan
IHSS	Individual Hazardous Substance Site
LOAEL	lowest observed adverse effect level
µg/kg	micrograms per kilogram (may be found as ug/kg)
MDC	maximum detected concentration
mg/kg	milligrams per kilogram
NOAEL	no observed adverse effect level
pCi/g	picocuries per gram
RFETS or Site	Rocky Flats Environmental Technology Site
SAP	Sampling and Analysis Plan
SID	South Interceptor Ditch
UCL	upper confidence limit
UTL	upper tolerance limit
WC AEU	Woman Creek Aquatic Exposure Unit

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1.0 INTRODUCTION AND SITE SETTING

The purpose of this appendix is to provide a summary of potential ecological risk for the Individual Hazardous Substance Site (IHSS) Group NE-1 areas of interest (Pond C-2) for the Woman Creek Aquatic Exposure Unit (EU) (AEU) (WC AEU). The Comprehensive Risk Assessment (CRA) Methodology (DOE 2004a) was followed, in which the WC AEU, including ponds and drainages, was evaluated. Through this process ecological contaminants of potential concern (ECOPCs) are identified and their locations within the drainage are determined. This process focuses on contaminants of potential concern that occur in the WC AEU ponds, while following the drainage-wide approach that focuses on the ecological endpoint of protecting aquatic populations throughout the AEU.

This appendix presents the ECOPCs identified by the CRA Methodology (DOE 2004a) process that could pose a risk to aquatic receptors if all materials associated with the WC AEU were left in place. This appendix represents a component of work outlined within the Industrial Area (IA) and Buffer Zone (BZ) Sampling and Analysis Plan (SAP) (IABZSAP) Appendix D (DOE 2004b), which addresses the accelerated action process. A complete assessment of the WC AEU will be provided in Volume 15 of the CRA.

For the ECOPCs, standard risk characterization techniques were applied to determine which analytes have the potential to cause risk to the population of aquatic receptors in the Woman Creek drainage. Further analysis techniques, such as frequency of detection, and spatial extent, and results of other studies were also included as additional lines of evidence from the CRA Methodology (DOE 2004a). Section 2.0 provides a summary of the ECOPC process, and Section 3.0 summaries the conclusions.

The hydrology in the Woman Creek tributaries is expected to remain unchanged when Rocky Flats Environmental Technology Site (RFETS) closes with the exception of the South Interceptor Ditch (SID), where water flow will be reduced. Woman Creek flows through Pond C-1, which was reconfigured as a low-profile, flow-through structure in 2005. Woman Creek is isolated from the IA surface runoff by the SID, which intercepts surface flow and diverts it to Pond C-2. Woman Creek is diverted around Pond C-2 via a concrete diversion wall and channel, rejoining the original Woman Creek channel downstream of Pond C-2.

Aquatic habitats within the WC AEU are restricted to the headwaters of Woman Creek and its tributaries (that is, the area north of Pond C-2). Intermittent stream flows alternate with areas of persistent flow within the headwaters. Intermittent steam segments have isolated pools that provide important habitat for many aquatic species during late summer and early fall when flow ceases. Persistent flows originate from seeps and springs and provide year-round aquatic habitats.

Pond C-2 is hydrologically isolated from Woman Creek and receives flow from the SID. The SID provides only marginal ephemeral habitats. These ephemeral habitats consist of a few small pools where water collects during storm events. These areas dry out quickly. Below Pond C-2 only one or two small pools remain most of the year in lower Woman Creek. The rest of this reach is dry the majority of the year.

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Woman Creek retains a significant amount of stream habitat and holds the majority of RFETS fish species. Native fish species that reproduce within Woman Creek include white suckers (*Catostomus commersoni*), fathead minnows (*Pimephales promelas*), green sunfish (*Lepomis cyanellus*), stonerollers (*Capostoma anomalus*), and creek chubs (*Semotilus atromaculatus*). Two non-native fish species, golden shiners (*Notemigonus crysoleucas* and largemouth bass (*Micropterus salmoides*), also are found in the drainage.

Within Woman Creek, the most common aquatic macroinvertebrates are Oligochaetes (tubificid worms) (DOE 2003), and larvae of the blackfly (Order *Diptera, Simulidae* sp.), midge (Order *Diptera, Chironomidae* sp), and mayfly (Order *Ephemeroptera*) (DOE 1995). Other species include caddisflies (Order *Trichoptera*), craneflies (*Tipulidae* ssp.), and damselfly larvae (Order *Odonata*), and stonefly larvae (Order *Plecoptera*), as well as snails (Class *Gastropoda*) and amphipods (Order *Amphipoda*). Large macroinvertebrates, such as crayfish (Order *Decapoda,* Family *Astacidae*) and snails, are potentially important prey for other fish, waterfowl, and mammal species.

Characterization of the aquatic habitat provided by Woman Creek is of primary consideration with regards to aquatic risk. Attachment 1 provides a more detailed summary of the WC AEU ecological setting. Currently sustained flows exist in portions of the creek that support aquatic species. Given the nature of ongoing accelerated actions, the location and amount of viable aquatic habitat that will be present after accelerated actions are complete is unclear because overland flow will be altered by the IA accelerated actions and the removal of buildings and pavement.

2.0 ECOLOGICAL CONTAMINANTS OF POTENTIAL CONCERN IDENTIFICATION AND RISK CHARACTERIZATION

The methods and results of both the ECOPC and risk characterization processes for sediment are described below. The process follows the CRA Methodology. Data for the WC AEU were evaluated to determine whether they were adequate for the CRA and for this evaluation. Data were determined adequate and the data adequacy evaluation is described in Volume 2 of the CRA (DOE 2005).

2.1 Ecological Contaminants of Potential Concern Identification Process and Results

Table C-1 summarizes the results of the sediment ECOPC identification process. Each successive step involved in the process is outlined within this table. The methods involved with each step, and their outcome, are described below.

The first step in the ECOPC identification process is a comparison of maximum detected concentrations (MDCs) of the ecological contaminants of interest (ECOIs) to the CRA Methodology-defined ecological screening levels (ESLs). If an MDC exceeds the ESL, the ECOI is retained for further analysis. Those ECOIs that have no ESLs available are retained for further assessment as ECOIs of uncertain toxicity in the uncertainty section of the CRA (Volume 15b) and will not be discussed further in this document.

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Table C-1
ECOPC Screening Step for Sediment in the WC AEU

ECOI	MDC	Sediment ESL	MDC > ESL?	Detection Frequency (DF)	DF > 5%?	> BKG?	95th UTL > ESL?	ECOPC?
Inorganics (mg/kg)								
Aluminum	30200	15900	Yes	100%	Yes	Yes	Yes	**Yes**
Antimony	51.3	2	Yes	7%	Yes	Yes	Yes	**Yes**
Arsenic	9.8	9.79	Yes	96%	Yes	Yes	No	No
Barium	404	189	Yes	98%	Yes	Yes	Yes	**Yes**
Beryllium	1.7	N/A	N/A	64%	Yes	No	N/A	No
Boron	14	N/A	N/A	100%	Yes	Yes	N/A	No
Cadmium	3.6	0.99	Yes	24%	Yes	Yes	Yes	**Yes**
Calcium	48200	N/A	N/A	100%	Yes	Yes	N/A	No
Cesium	5.2	N/A	N/A	31%	Yes	No	N/A	No
Chromium	70.1	43.4	Yes	98%	Yes	Yes	No	No
Chromium VI	0.012	43.4	No	25%	Yes	Yes	N/A	No
Cobalt	12.8	N/A	N/A	92%	Yes	Yes	N/A	No
Copper	212	31.6	Yes	88%	Yes	Yes	Yes	**Yes**
Fluoride	20.3	0.01	Yes	25%	Yes	Yes	Yes	**Yes**
Iron	29700	20000	Yes	100%	Yes	Yes	Yes	**Yes**
Lead	118	35.8	Yes	100%	Yes	Yes	Yes	**Yes**
Lithium	18.2	N/A	N/A	84%	Yes	No	N/A	No
Magnesium	6600	N/A	N/A	100%	Yes	Yes	N/A	No
Manganese	1580	630	Yes	100%	Yes	Yes	No	No
Mercury	3.8	0.18	Yes	20%	Yes	No	N/A	No
Molybdenum	0.56	N/A	N/A	2%	No	No	N/A	No
Nickel	32.1	22.7	Yes	73%	Yes	Yes	Yes	**Yes**
Nitrate / Nitrite	32	N/A	N/A	74%	Yes	No	N/A	No
Potassium	3440	N/A	N/A	82%	Yes	Yes	N/A	No
Selenium	3.8	0.95	Yes	28%	Yes	Yes	Yes	**Yes**
Silver	7.7	1	Yes	11%	Yes	No	N/A	No
Sodium	2060	N/A	N/A	86%	Yes	No	N/A	No
Strontium	167	N/A	N/A	98%	Yes	Yes	N/A	No
Thallium	1.6	N/A	N/A	16%	Yes	Yes	N/A	No
Tin	77.2	N/A	N/A	10%	Yes	No	N/A	No
Titanium	190	N/A	N/A	100%	Yes	Yes	N/A	No
Vanadium	68.6	N/A	N/A	100%	Yes	Yes	N/A	No
Zinc	2080	121	Yes	100%	Yes	Yes	Yes	**Yes**
Organics (ug/kg)								
2-Butanone	380	N/A	N/A	16%	Yes	N/A	N/A	No
2-Methylnaphthalene	110	20.2	Yes	2%	No	N/A	N/A	No
4,4'-DDT	18	4.16	Yes	2%	No	N/A	N/A	No
4-Methyl-2-pentanone	3	N/A	N/A	2%	No	N/A	N/A	No
4-Methylphenol	510	12.3	Yes	8%	Yes	N/A	Yes	**Yes**
Acenaphthene	510	6.71	Yes	2%	No	N/A	N/A	No
Acetone	890	N/A	N/A	21%	Yes	N/A	N/A	No

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ECOI	MDC	Sediment ESL	MDC > ESL?	Detection Frequency (DF)	DF > 5%?	> BKG?	95th UTL > ESL?	ECOPC?
Aldrin	0	8.25	No	3%	No	N/A	N/A	No
alpha-Chlordane	0	3.24	No	3%	No	N/A	N/A	No
Anthracene	470	57.2	Yes	2%	No	N/A	N/A	No
Benzo(a)anthracene	1200	108	Yes	12%	Yes	N/A	Yes	**Yes**
Benzo(a)pyrene	970	150	Yes	10%	Yes	N/A	Yes	**Yes**
Benzo(b)fluoranthene	1500	N/A	N/A	8%	Yes	N/A	N/A	No
Benzo(k)fluoranthene	690	240	Yes	8%	Yes	N/A	Yes	**Yes**
Benzoic Acid	660	N/A	N/A	12%	Yes	N/A	N/A	No
beta-BHC	0	2.37	No	3%	No	N/A	N/A	No
bis(2-Ethylhexyl)phthalate	2600	24900	No	56%	Yes	N/A	N/A	No
Butylbenzylphthalate	210	11400	No	3%	No	N/A	N/A	No
Chrysene	1200	166	Yes	17%	Yes	N/A	Yes	**Yes**
delta-BHC	0	2.37	No	3%	No	N/A	N/A	No
Dibenz(a,h)anthracene	220	33	Yes	2%	No	N/A	N/A	No
Dibenzofuran	230	325	No	2%	No	N/A	N/A	No
Diethylphthalate	79	108	No	3%	No	N/A	N/A	No
Di-n-butylphthalate	70	612	No	18%	Yes	N/A	N/A	No
Di-n-octylphthalate	96	N/A	N/A	7%	Yes	N/A	N/A	No
Endosulfan I	0	0.69	No	3%	No	N/A	N/A	No
Fluoranthene	2900	423	Yes	26%	Yes	N/A	Yes	**Yes**
Fluorene	400	77.4	Yes	2%	No	N/A	N/A	No
gamma-BHC (Lindane)	4.4	2.37	Yes	2%	No	N/A	N/A	No
Heptachlor	3.1	0.132	Yes	5%	Yes	N/A	Yes	**Yes**
Heptachlor epoxide	0	2.47	No	3%	No	N/A	N/A	No
Indeno(1,2,3-cd)pyrene	440	17	Yes	4%	No	N/A	N/A	No
Methylene Chloride	220	N/A	N/A	19%	Yes	N/A	N/A	No
Naphthalene	300	176	Yes	4%	No	N/A	N/A	No
[a]Aroclor-1254	250	40	Yes	0%	Yes	N/A	Yes	**Yes**
Phenanthrene	2900	204	Yes	19%	Yes	N/A	Yes	**Yes**
Phenol	150	773	No	2%	No	N/A	N/A	No
Pyrene	3100	195	Yes	24%	Yes	N/A	Yes	**Yes**
Tetrachloroethene	1	3050	No	4%	No	N/A	N/A	No
Toluene	520	1660	No	25%	Yes	N/A	N/A	No
Trichloroethene	23	22800	No	2%	No	N/A	N/A	No
Radionuclides (pCi/g)								
Americium-241	0.869	5150	No	83%	Yes	Yes	N/A	No
Cesium-137	0.5643	3120	No	87%	Yes	N/A	N/A	No
Gross Alpha	320	N/A	N/A	100%	Yes	N/A	N/A	No
Gross Beta	74.93	N/A	N/A	100%	Yes	N/A	N/A	No
Plutonium-239/240	182	5860	No	92%	Yes	Yes	N/A	No
Radium-226	2.19	101	No	100%	Yes	N/A	N/A	No
Radium-228	2.9	87.8	No	100%	Yes	N/A	N/A	No
Strontium-89/90	0.0192	582	No	25%	Yes	N/A	N/A	No
Uranium-233/234	4.775	N/A	N/A	100%	Yes	N/A	N/A	No
Uranium-235	0.265	3730	No	70%	Yes	N/A	N/A	No

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ECOI	MDC	Sediment ESL	MDC > ESL?	Detection Frequency (DF)	DF > 5%?	> BKG?	95th UTL > ESL?	ECOPC?
Uranium-238	10.13	2490	No	100%	Yes	N/A	N/A	No

[a] PCBs will be evaluated as total PCB.

The ECOIs were further evaluated based on their frequency of detection. For sediment, there were several ECOIs detected in less than 5 percent of the sediment samples. These ECOIs and corresponding figures include acenaphthene (Figure C-1), anthracene (Figure C-2), dibenz(a,h)anthracene (Figure C-3), fluorene (Figure C-4), gamma-BHC (Figure C-5), 2-methylnaphthalene (Figure C-6), indeno(1,2,3-cd)pyrene (Figure C-7), naphthalene (Figure C-8), and 4,4'-DDT (Figure C-9).

Based on a review of the spatial extent of these chemicals with detection frequencies less than 5 percent (Figures C-1 through C-9), most of these ECOIs are located outside the stream channel and within the interceptor ditch, or within a portion of the IA that overlaps the WC AEU, with the exception of naphthalene which occurs within the stream channel. These chemicals are not associated with the ponds and typically occur in only one location. In order for an aquatic population within a pond to be affected, a chemical needs to have an extensive spatial occurrence at concentrations of concern. This is not the case for any of these chemicals. These ECOIs are eliminated from further consideration in Woman Creek because they are unlikely to present risks to the population of receptors that may inhabit the drainage.

The distributions of the inorganic ECOIs were compared to the distribution of ECOI concentrations in the site-specific background sets. The background comparison step follows the process agreed to through the consultative process with the regulatory agencies and documented in Volume 2 of the CRA.

Data distributions for mercury and silver were not significantly greater than the distribution concentrations in the sitewide background sediment data set. Mercury and silver were eliminated from further consideration because the risk posed by these two elements would not exceed the risk already associated with background conditions.

The final step in the ECOPC identification process involved calculating an upper-bound exposure point concentration (EPC) for all remaining ECOIs, which was then compared to the CRA Methodology ESL. This EPC is calculated as the 95th upper tolerance limit (UTL) (95th upper confidence limit [UCL] of the 90th percentile). Where sufficient data were unavailable to calculate statistical parameters, the MDC was used as the default EPC. The EPC was then compared to the ESL from the CRA Methodology. EPCs that exceed their respective ESLs for a given ECOI are identified as final ECOPCs and are discussed further in this assessment.

The maximum EPCs for arsenic, chromium, and manganese in sediment were greater than their respective ESLs. However, the UTL EPCs for these ECOIs were less than the ESLs. Therefore, in accordance with the CRA Methodology, these chemicals were removed from further evaluation. To ensure that these ECOIs did not pose a risk in sediment for an isolated aquatic population of Woman Creek, the spatial distributions of these ECOIs were evaluated by plotting the measured concentrations compared to the

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ESL and a toxicity threshold (typically representative of a lowest observed adverse effect level [LOAEL] or other applicable value).

Attachment 2 provides a summary of the toxicity thresholds and their endpoints. The CRA Methodology (DOE 2004a) ESLs represent a conservative benchmark for screening comparisons, while the toxicity thresholds represent a less conservative benchmark correlating to a mid-range or lowest effect level concentration. Comparison of an EPC to both the ESL and toxicity threshold helps to put into perspective the risk potential attributable to a given ECOPC. The distributions of arsenic, chromium, and manganese are shown on Figures C-10, C-11, and C-12, respectively and typically occur at concentrations less than the ESLs. Arsenic occurs at concentrations below the ESL throughout the drainage, with one exception. A single location within Pond C-2 has a measured concentration above the ESL, but below the toxicity threshold. Chromium has a single measured value greater than the ESL, which occurs in the SID. Manganese has two measured values greater than the ESL, both within the channel of Woman Creek and not within the pond areas. The distributions of arsenic, chromium, and manganese in Woman Creek and the ponds do not pose a risk because the measured concentrations are less than threshold values.

Additional data have been gathered for Woman Creek with regards to dioxins in depositional areas. Three samples from the lower Woman Creek drainage area were collected and analyzed. The evaluation of these results is provided in Attachment 3.

2.2 Risk Characterization

The ECOPC identification process defined the steps necessary to identify the chemicals that could not reliably be removed from further consideration in the screening process. The list of ECOPCs represents those chemicals in the AEU that require further assessment by means of the risk characterization, presented in this document. The ECOPCs requiring further evaluation include the following:

- Aluminum;
- Antimony;
- Barium;
- Cadmium;
- Copper;
- Fluoride;
- Iron;
- Lead;
- Nickel;
- Selenium;
- Zinc;
- 4-Methylphenol;
- Benzo(a)anthracene;
- Benzo(a)pyrene;
- Benzo(k)fluoranthene;
- Chrysene;
- Fluoranthene;

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- Heptachor;
- Aroclor-1254;
- Phenanthrene; and
- Pyrene.

For the purposes of this risk characterization, all available sediment data for the WC AEU were used. The UTL ECOPC concentrations were used as the EPCs. If the UTL result was greater than the MDC, the MDC was used as the EPC for the risk estimation.

Several lines of evidence were compiled to complete the risk characterization of the WC AEU. The following strategies were applied:

1. Using the hazard quotient (HQ) method, both the UTL (or maximum, whichever was less) and 95% UCL EPC were compared to the original ESL and the appropriate chemical toxicity threshold (Table C-2). The HQs were developed using the following standard equation: EPC/ESL or Toxicity Threshold = HQ. Only those chemicals that yielded HQs greater than 1 using the ESL for both the UTL and 95% UCL EPC were retained for further analysis (Step 2 below).

2. For the purposes of the accelerated action, only those ECOPCs requiring further risk characterization were mapped (Figures C-13 through C-25). Each sampling location with a detected ECOPC value is shown. The result is compared to appropriate ESLs and defined as having low (less than the CRA Methodology-defined ESL, no observed adverse effect level [NOAEL], or equivalent), low-to-moderate (greater than the CRA Methodology ESL, but less than the toxicity threshold), or moderate (greater than the toxicity threshold) risk potential.

2.2.1 Results of the Hazard Quotient Analysis

Results of the HQ analysis for sediment indicated the following:

- The risk potential attributable to aluminum, barium, cadmium, copper, lead, nickel, selenium, benzo(k)fluoranthene, and fluoranthene was low because HQ values were at or below 1.

- Sediment ECOPCs that require further analysis include antimony, fluoride, iron, zinc, heptachlor, 4-methylphenol, benzo(a)anthracene, benzo(a)pyrene, chrysene, Aroclor-1254, phenanthrene, and pyrene.

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Table C-2
HQs for Sediment ECOPCs in the WC AEU

ECOPC[a]	ESL	Toxicity Threshold	95 UTL EPC HQs			95 UCL EPC HQs			Further Characterization Required?
			EPC	ESL-HQ	Tox.Threshold-HQ	EPC	ESL-HQ	Tox.Threshold-HQ	
Aluminum	15900	58000	16100	1	0.3	10300	1	0.2	No
Antimony	2	3.2	19.55	**10**	6	12.8	**6**	4	**Yes**
Barium	189	287	256	1	1	144	1	1	No
Cadmium	0.99	4.98	1.8	2	0.3	0.895	1	0.2	No
Copper	31.6	149	167	5	1	38.2	1	0.3	No
Fluoride	0.01	7	20.3	**2030**	3	53.6	**5360**	*8*	**Yes**
Iron	2000	280000	24590	**12**	0.3	14800	**7**	0.1	**Yes**
Lead	35.8	128	55.6	2	0.4	29.6	1	0.2	No
Nickel	22.7	48.6	26.9	1	1	13.9	1	0.3	No
Selenium	0.95	5	1.6	2	0.3	0.834	1	0.2	No
Zinc	121	459	728	*6*	2	714	**6**	2	**Yes**
4-Methylphenol	12.3	670	510	***41***	1	341	**28**	1	**Yes**
Benzo(a)anthracene	108	1050	900	**8**	1	448	**4**	0.4	**Yes**
Benzo(a)pyrene	150	1450	900	**6**	1	436	**3**	0.3	**Yes**
Benzo(k)fluoranthene	240	750	690	3	1	348	1	0.5	No
Chrysene	166	1290	900	***5***	1	435	**3**	0.3	**Yes**
Fluoranthene	423	2230	900	2	0.3	560	1	0.3	No
Heptachlor	0.132	16	3.1	**23**	0.3	16.4	**124**	1	**Yes**
Aroclor-1254	40	300	250	**4**	1	329	**5**	1	**Yes**
Phenanthrene	204	1170	900	**4**	1	571	**3**	0.5	**Yes**
Pyrene	195	1520	900	**5**	1	587	**3**	0.4	**Yes**

[a] Bold chemicals require further risk characterization.

2.2.2 Results of the Spatial Extent Analysis

The spatial extent of the sediment ECOPCs with elevated HQs is provided on Figures C-13 through C-25. The spatial extent of these chemicals demonstrates the following trends:

- For antimony (Figure C-13), iron (Figure C-15), and heptachlor (Figure C-17), the risk was low because the observed concentrations generally occur below ESLs. There are a select few locations within the channel of Woman Creek, where concentrations of each of these chemicals that exceed the ESLs. There is no depositional trend for these chemicals that would create isolated areas, such as a pond, to be affected. The spatial extent of these chemical concentrations predominantly occur at levels below toxicity thresholds indicating a low to moderate risk. The risk to a population within Woman Creek would be low because measured ECOPC concentrations were predominantly less than the ESLs. The risk to a population within the pond areas of Woman Creek is also low. No further evaluation is required.

- For fluoride (Figure C-14), 4-methylphenol (Figure C-18), benzo(a)anthracene (Figure C-19), benzo(a)pyrene (Figure C-20), chrysene (Figure C-21), Aroclor-1254 (Figures C-22 and C-25), phenanthrene (Figure C-23), and pyrene (Figure C-24), the measured concentrations within the drainage were predominantly below ESL levels indicating a low risk potential. The only locations with measured values greater than the ESLs occurred within the SID, or in areas where the IA overlapped with the WC AEU. Aroclor-1254 was further evaluated on Figure C-25, which depicts the measured concentrations. These values occur below the toxicity threshold of 300 micrograms per kilogram (ug/kg), which represents a low to moderate risk potential. All measured values occur within the SID, which does not provide aquatic habitat. There are no elevated values for Aroclor-1254 within the pond areas. The risk to aquatic populations attributable to these chemicals within the drainage would be considered low. The risk to a population within the pond areas of Woman Creek is also low. No further evaluation is required.

- Zinc (Figure C-16) demonstrates a consistent presence at concentrations greater than the ESL, yet below the toxicity threshold, indicating a low to moderate risk potential. This occurs in areas north of, within, and south of the IA. It appears as if zinc occurs naturally at these levels, and may not be source-related. Zinc is not concentrated in any single location (such as Pond C-2) and would therefore not pose a risk to an isolated population of aquatic receptors.

3.0 SUMMARY AND CONCLUSIONS

Multiple lines of evidence were gathered to formulate the aquatic risk conditions within the WC AEU Pond C-2 area. The drainage-wide approach, as described within the CRA methodology, was followed. After ECOPCs were identified, the specific concerns associated with the ponds were evaluated. An evaluation of the risk potential was

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conducted using a standard HQ approach, along with an evaluation of the spatial extent of certain ECOPCs requiring further analysis. Certain chemicals were carried further by evaluation of other lines of evidence such as a thorough review of their spatial extent (that is, Aroclor-1254 as shown on Figure C-25).

Of the ECOPCs carried through the process, all were characterized as having low risk potential. The spatial distribution evaluation indicated similar trends among the ECOPCs evaluated. There were a few locations where observed concentrations exceeded ESL values. Detailed analysis of certain chemicals indicates the frequency and magnitude of the ECOPCs are not substantial compared to the ESLs and toxicity thresholds. Review of the spatial extent of the ECOPCs revealed that the chemicals did not occur in isolated portions of the drainage, such as Pond C-2. Therefore, there appears to be a low risk potential associated with the pond in particular.

Further evaluation of the aquatic conditions within Woman Creek indicates this drainage is controlled by flow conditions. The aquatic life within the system is highly susceptible to changes in flow, and in turn is represented as an opportunistic assemblage of aquatic species in certain portions, while sustaining flows in other areas support a diversity of life. There have been no studies to indicate water quality is a controlling factor to the ecology. Instead, it is well documented that flow conditions are the controlling factor that limit the amount of available habitat year-round. Attachment 1 provides additional details of the ecosystem health of the WC AEU.

In summary, the lines of evidence support the conclusion that there is a low risk potential to populations of aquatic life within Woman Creek as related to the ECOPCs. The overlying risk driver to these organisms is the habitat condition itself.

There are sources of uncertainty associated with this evaluation. For instance, it was assumed that all of Woman Creek is viable aquatic habitat and that all areas sampled are equally important to the support of populations. This is a very conservative assumption because areas within Woman Creek are limited due to intermittent flows. In the interest of being conservative, however, it was also assumed those ECOPCs in areas that are not suitable habitat (which were sampled due to the presence of sediment, and had a possible connection to the drainage hydrology as a whole) could contribute to possible future exposure conditions to aquatic receptors that reside downgradient of this potential source. This assumption likely overestimates the exposure of these receptors because the hydrologic connectivity is unknown or unlikely. A discussion of historic study findings that evaluate the aquatic condition within Woman Creek is provided in Attachment 1.

Another uncertainty is associated with the use and selection of the toxicity thresholds. Toxicity thresholds for sediment reflect effects conditions with various endpoints due to the sporadic nature of available literature information. If a measured ECOPC concentration occurs above these values, the magnitude of effect attributable to the exposure is unknown. A discussion of the endpoints associated with these toxicity thresholds is provided in Attachment 2.

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4.0 REFERENCES

DOE, 1995. Final Phase 1, RFI/RI Report, Woman Creek Priority Drainage, Operable Unit 5, Appendix N. Ecological Risk Assesment for Walnut Creek and Woman Creek Watersheds at the Rocky Flats Environmental Technology Site, Golden, Colorado, September

DOE, 2004a, Comprehensive Risk Assessment Work Plan and Methodology, Rocky Flats Environmental Technology Site, Golden, Colorado, September.

DOE, 2004b, Industrial Area and Buffer Zone Sampling and Analysis Plan, Modification 1, Rocky Flats Environmental Technology Site, Golden, Colorado, May.

DOE 2005, Comprehensive Risk Assessment, Rocky Flats Environmental Technology Site, Golden, Colorado (in prep).

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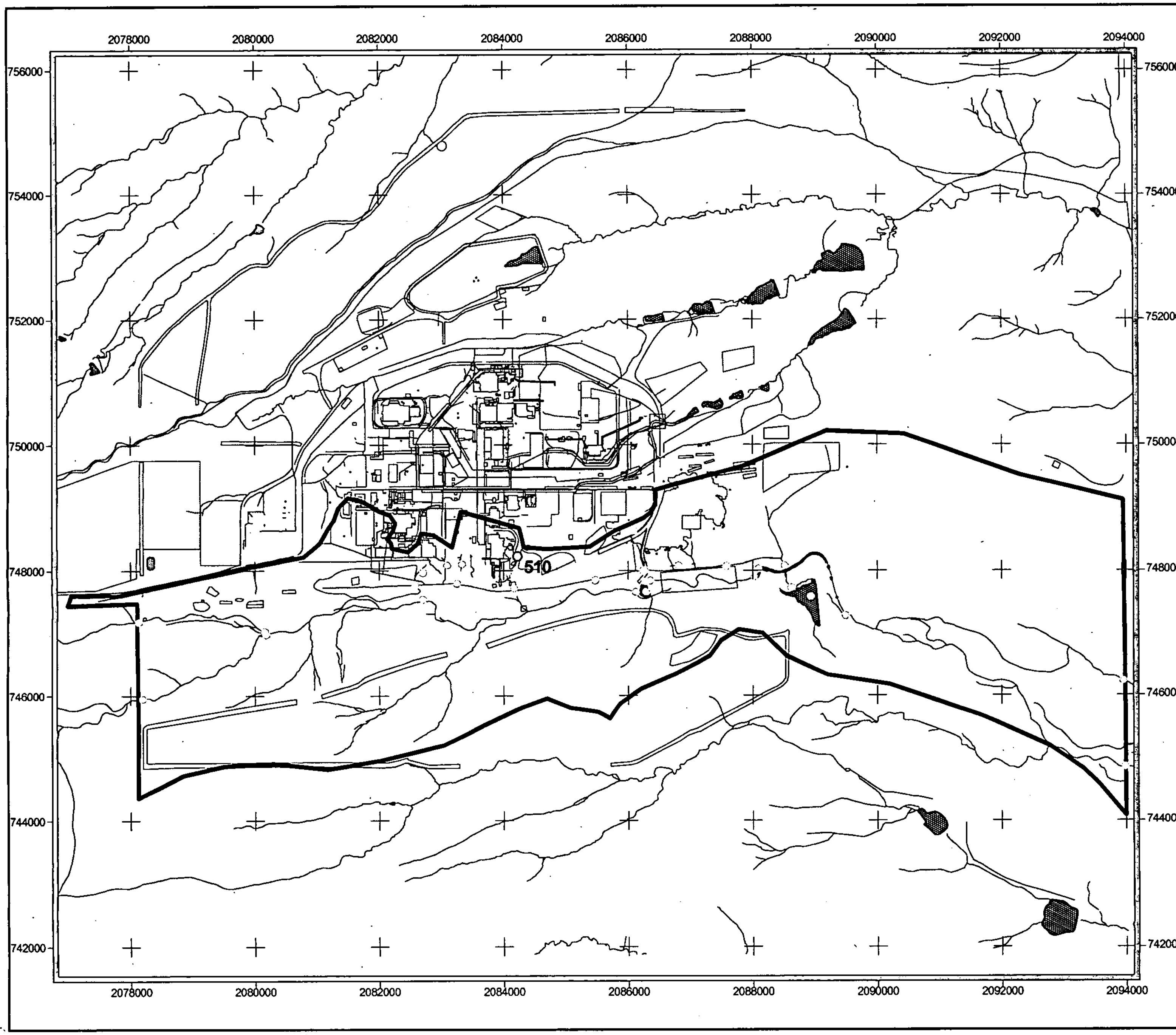

Figure C-1
Woman Creek AEU
Sediment Results
for Acenaphthene

KEY

1.0 Sample concentration (ug/kg)
Sampling location
O Detect
O Nondetect
Stream
Lake
Woman Creek AEU
IHSS/PAC/UBC

ESL = 6.71 ug/kg

DRAFT

Data Set: 12/15/04

N
W E
S

1000 0 1000 2000 Feet

Scale 1:28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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Date: 05/19/05

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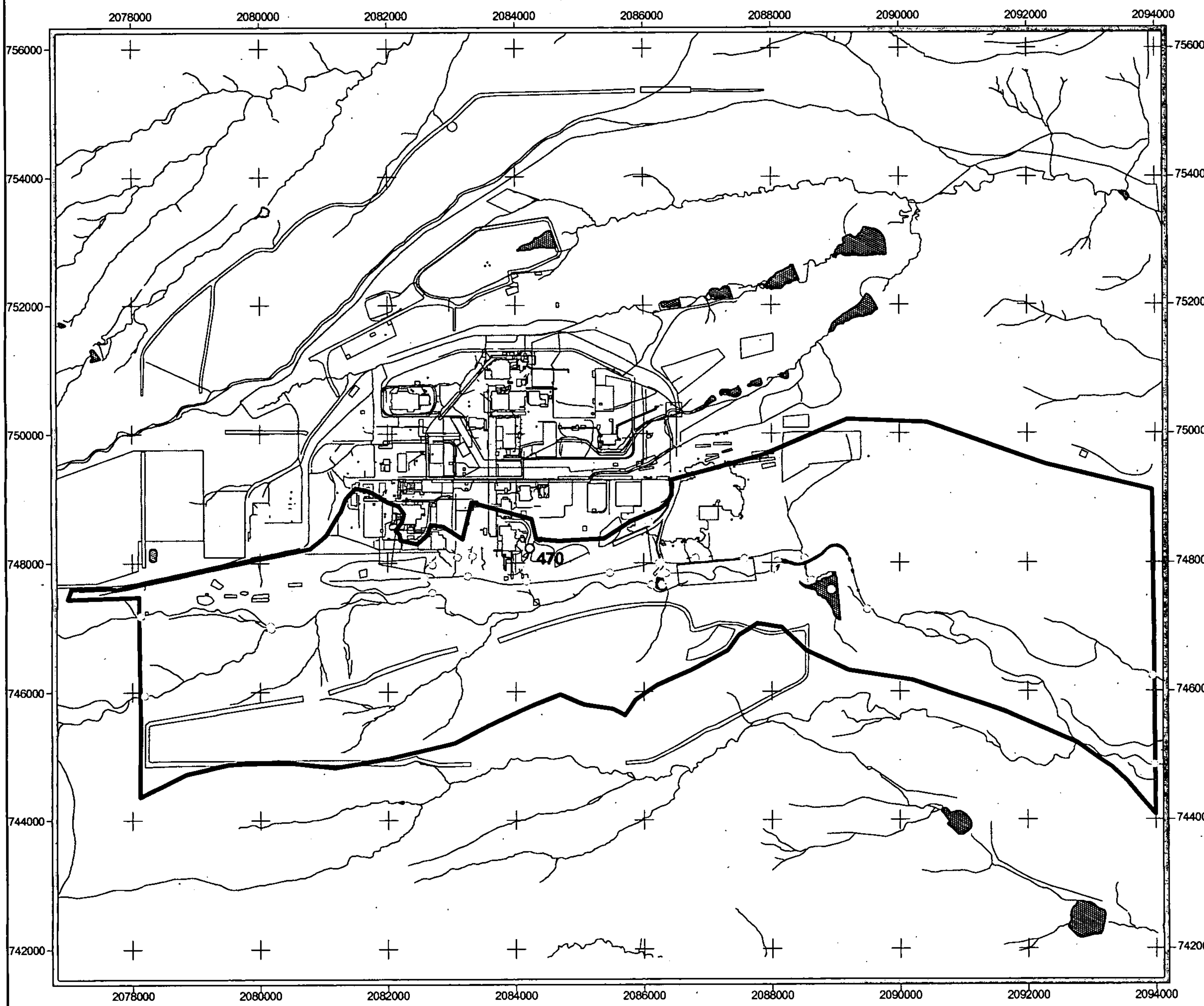

Figure C-2
Woman Creek AEU
Sediment Results
for Anthracene

KEY

1.0 Sample concentration (ug/kg)
Sampling location
O Detect
O Nondetect
Stream
Lake
Woman Creek AEU
IHSS/PAC/UBC

ESL = 57.2 ug/kg

DRAFT

Data Set: 12/15/04

N
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Scale 1:28,000
State Plane Coordinate Projection
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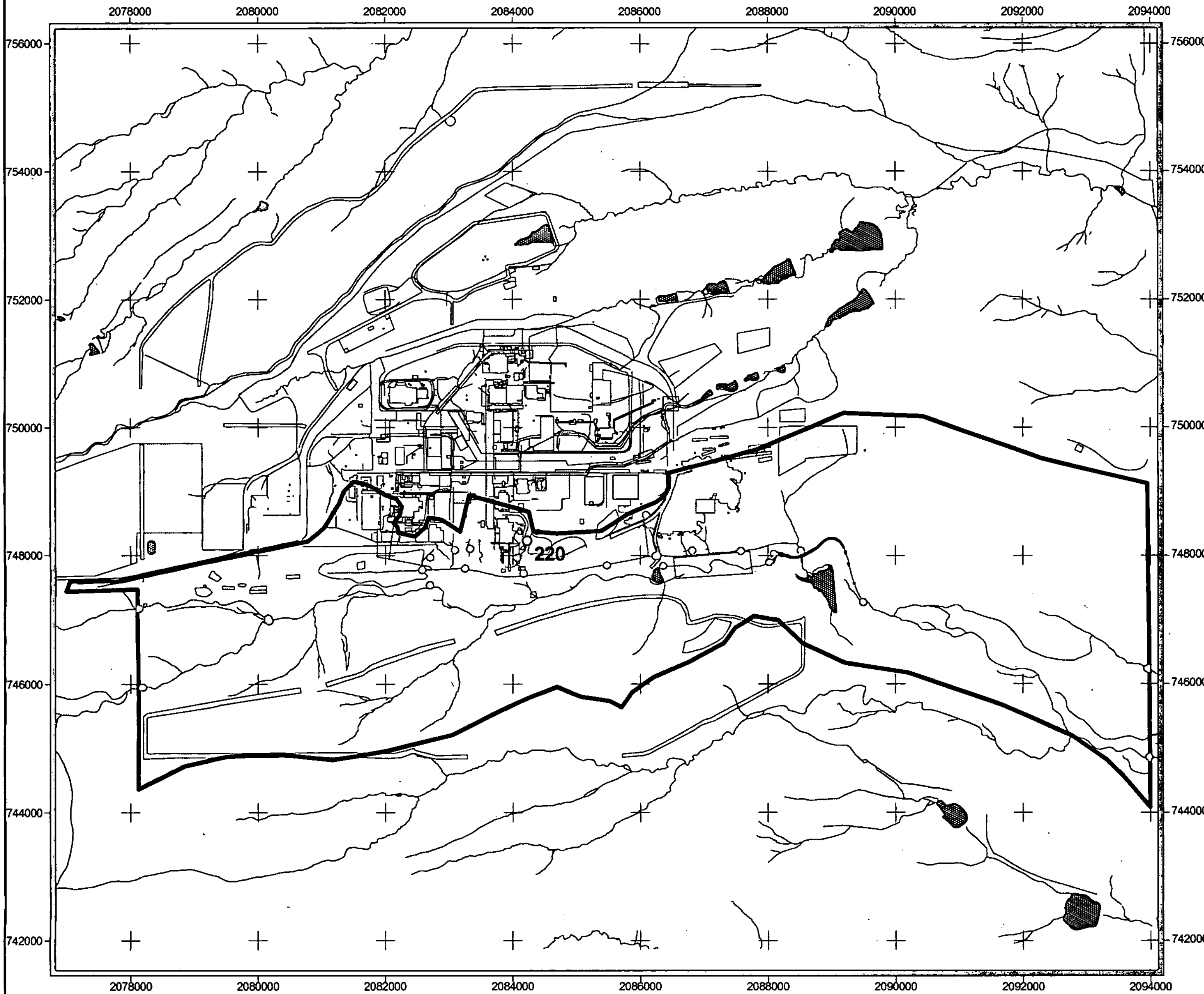

Figure C-3
Woman Creek AEU
Sediment Results
for Dibenz(a,h)anthracene

KEY

1.0 Sample concentration (ug/kg)
Sampling location
Detect
Nondetect
Stream
Lake
Woman Creek AEU
IHSS/PAC/UBC

ESL = 33 ug/kg

DRAFT

Data Set: 12/15/04

N
W
E
S

1000 0 1000 2000 Feet

Scale 1:28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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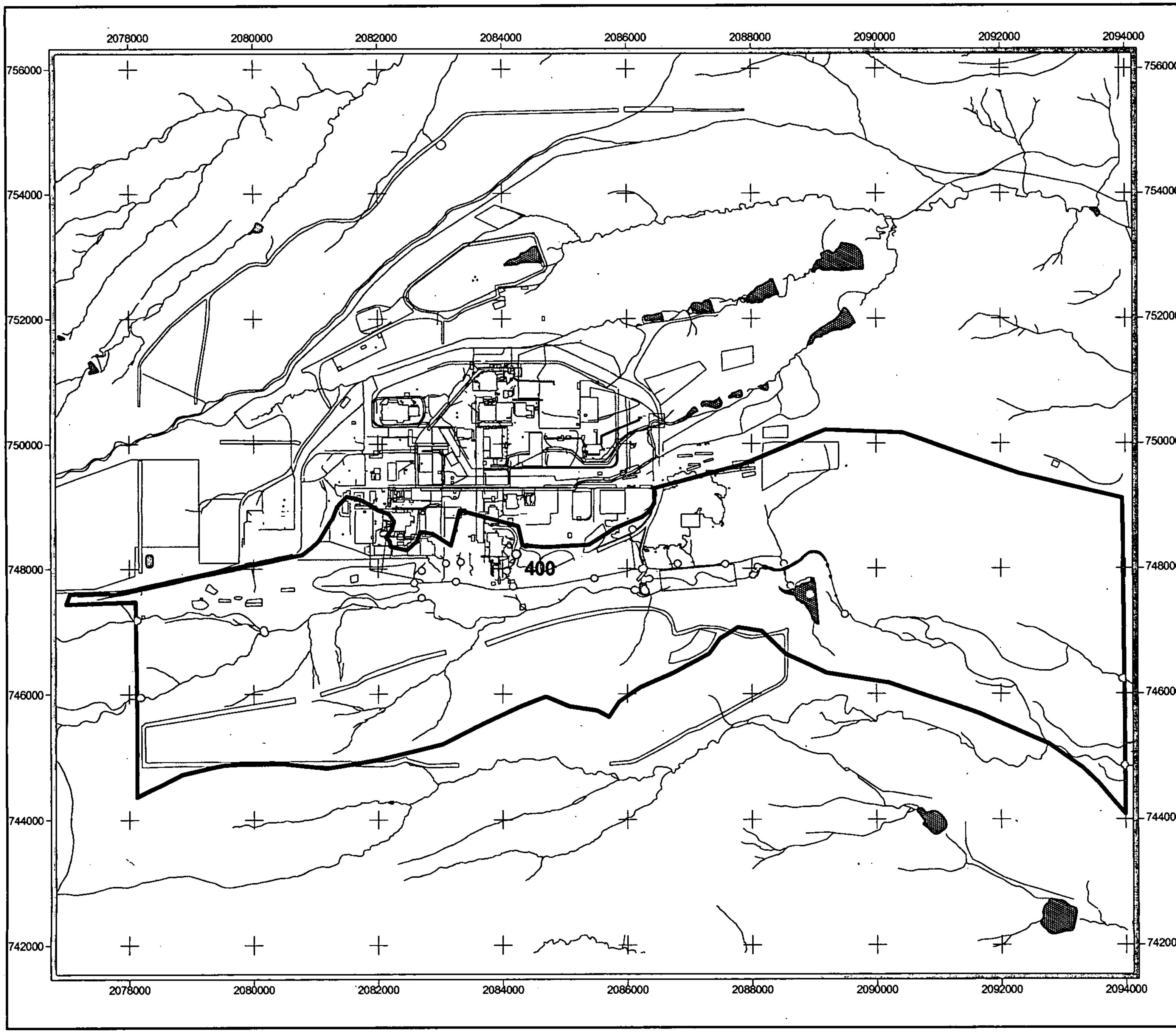

Figure C-4
Woman Creek AEU
Sediment Results
for Fluorene

KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Detect
- Nondetect
- Stream
- Lake
- Woman Creek AEU
- IHSS/PAC/UBC

ESL = 77.4 ug/kg

DRAFT

Data Set: 12/15/04

N
W E
S

1000 0 1000 2000 Feet

Scale 1:28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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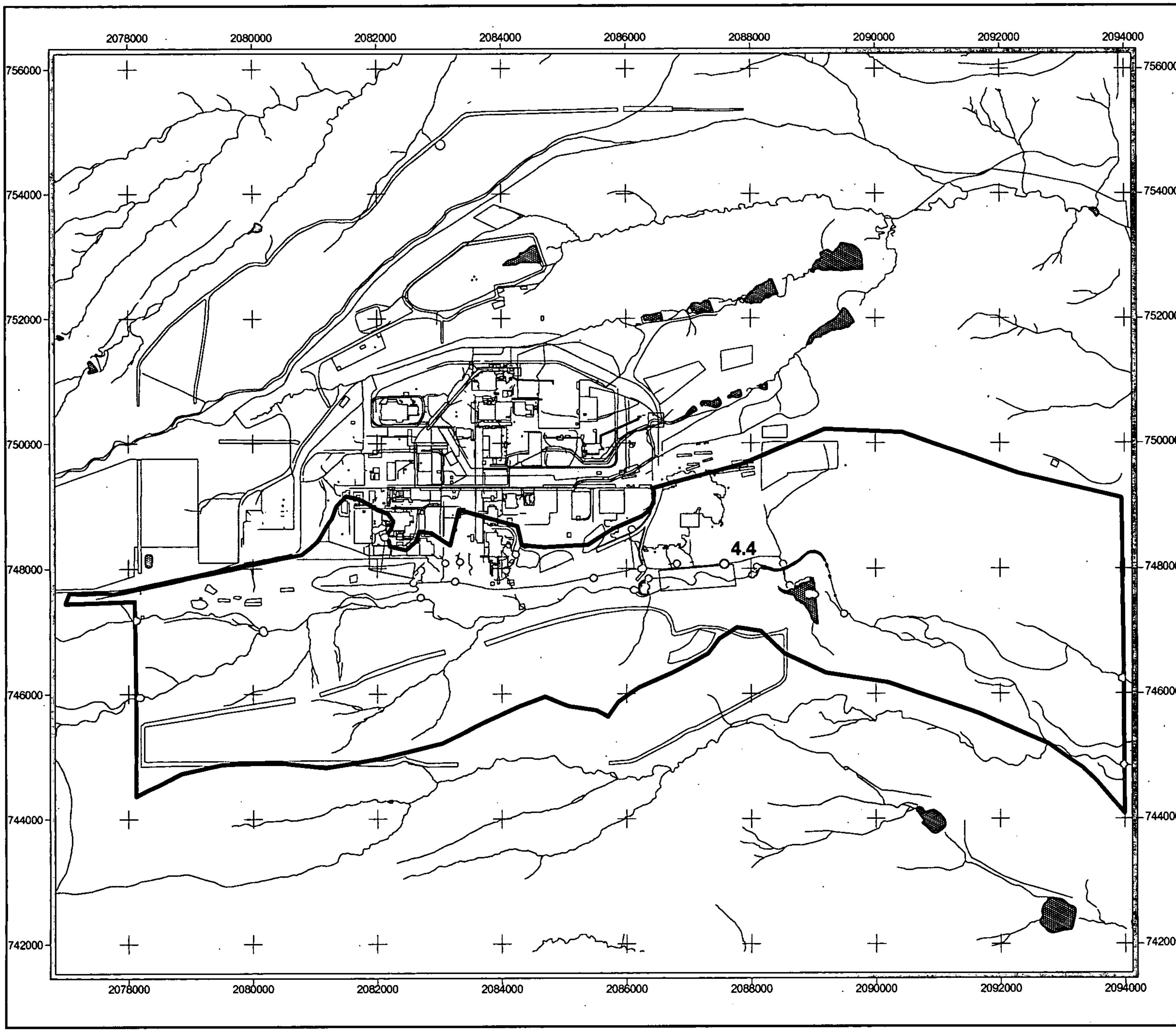

Figure C-5
Woman Creek AEU
Sediment Results
for Gamma-BHC

KEY

1.0 Sample concentration (ug/kg)
Sampling location
Detect
Nondetect
Stream
Lake
Woman Creek AEU
IHSS/PAC/UBC

ESL = 2.37 ug/kg

DRAFT

Data Set: 12/15/04

N
W E
S

1000 0 1000 2000 Feet

Scale 1:28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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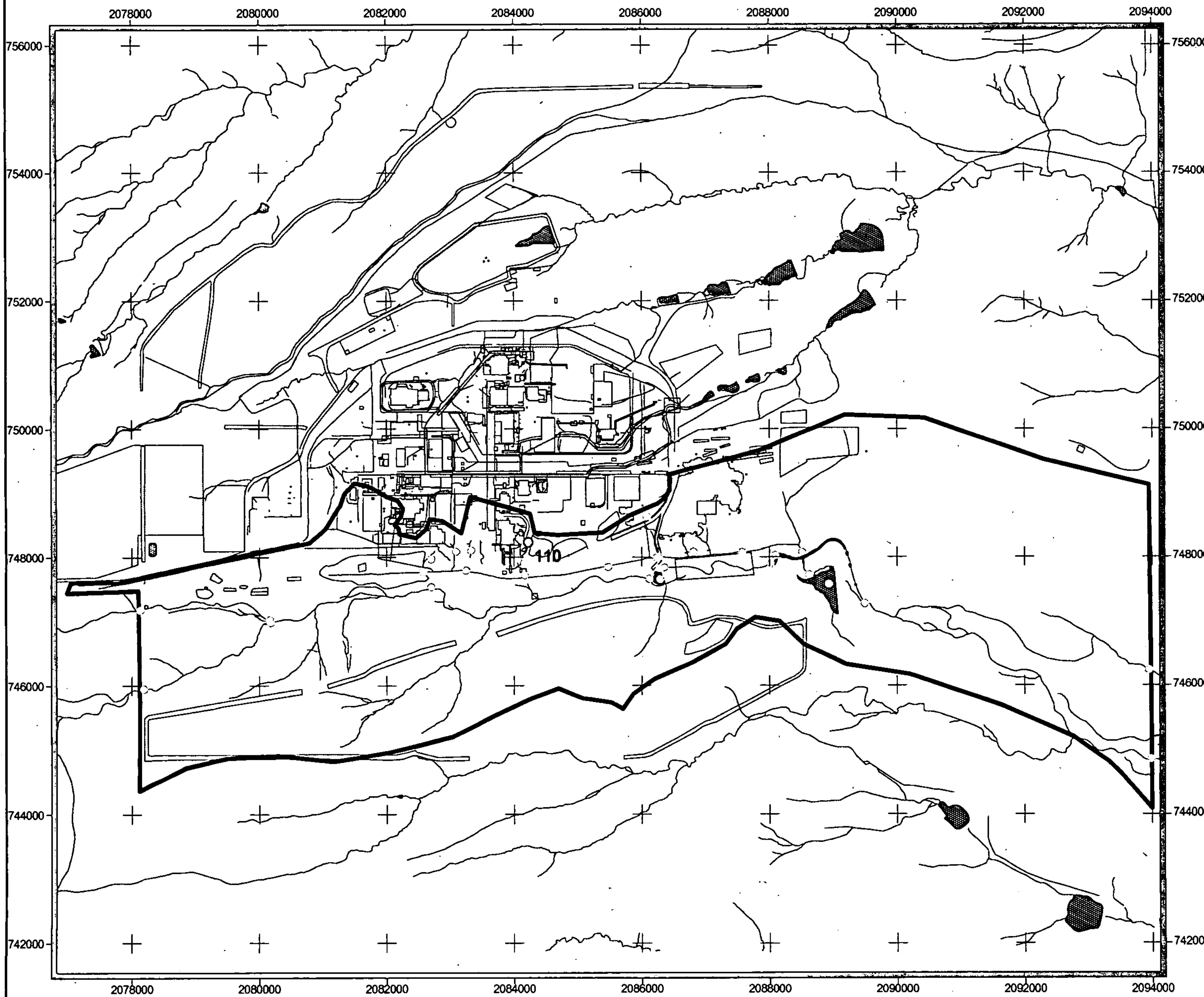

Figure C-6
Woman Creek AEU
Sediment Results
for 2-Methylnaphthalene

KEY

1.0 Sample concentration (ug/kg)

Sampling location
- O Detect
- O Nondetect
- Stream
- Lake
- Woman Creek AEU
- IHSS/PAC/UBC

ESL = 20.2 ug/kg

DRAFT

Data Set: 12/15/04

N W E S

1000 0 1000 2000 Feet

Scale 1:28,000
State Plane Coordinate Projection
Colorado Central Zone
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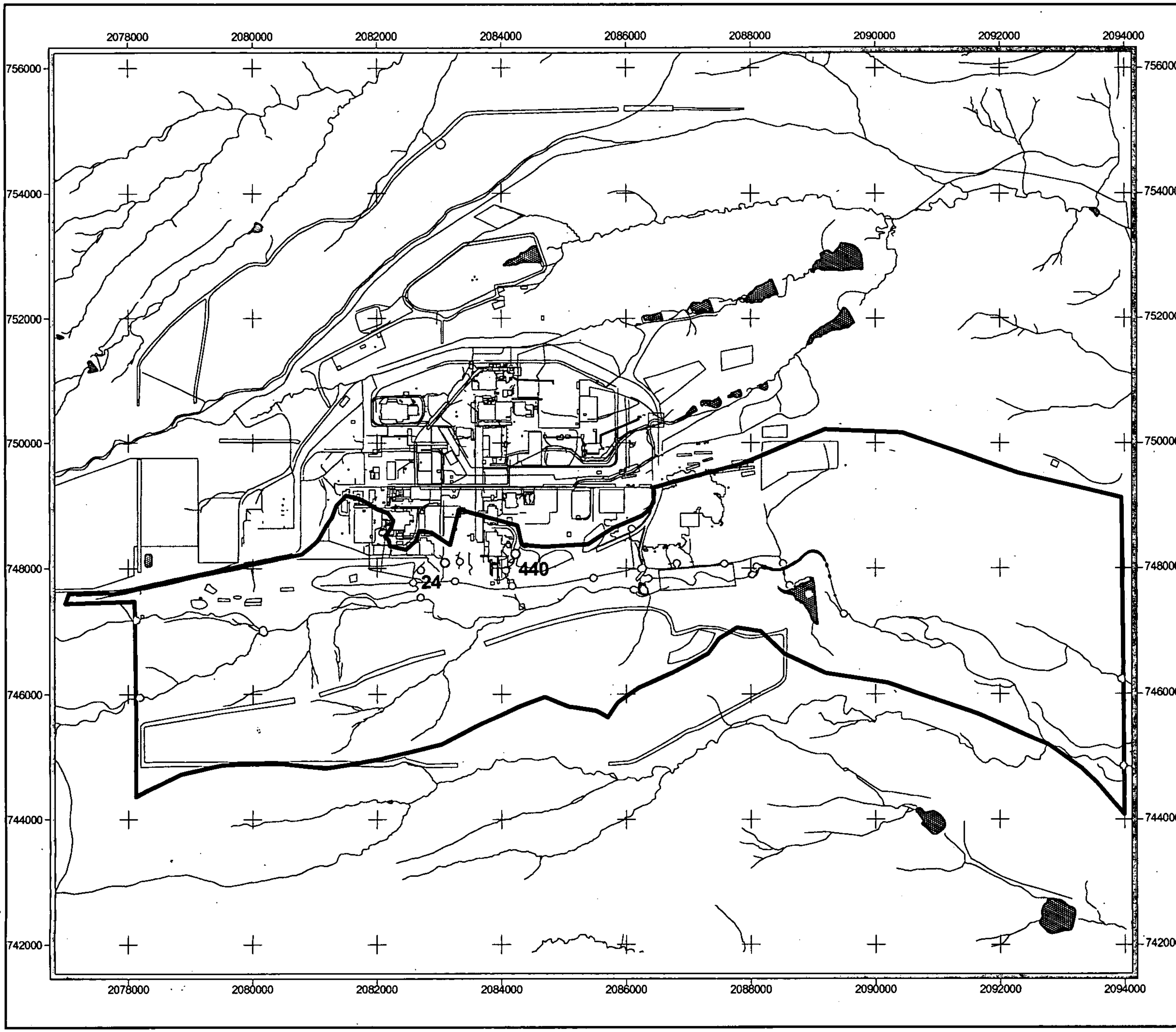

Figure C-7
Woman Creek AEU
Sediment Results
for Indeno(1,2,3-cd)pyrene

KEY

1.0 Sample concentration (ug/kg)

Sampling location

Detect

Nondetect

Stream

Lake

Woman Creek AEU

IHSS/PAC/UBC

ESL = 17 ug/kg

DRAFT

Data Set: 12/15/04

N
W E
S

1000 0 1000 2000 Feet

Scale 1:28,000

State Plane Coordinate Projection

Colorado Central Zone

Datum: NAD 27

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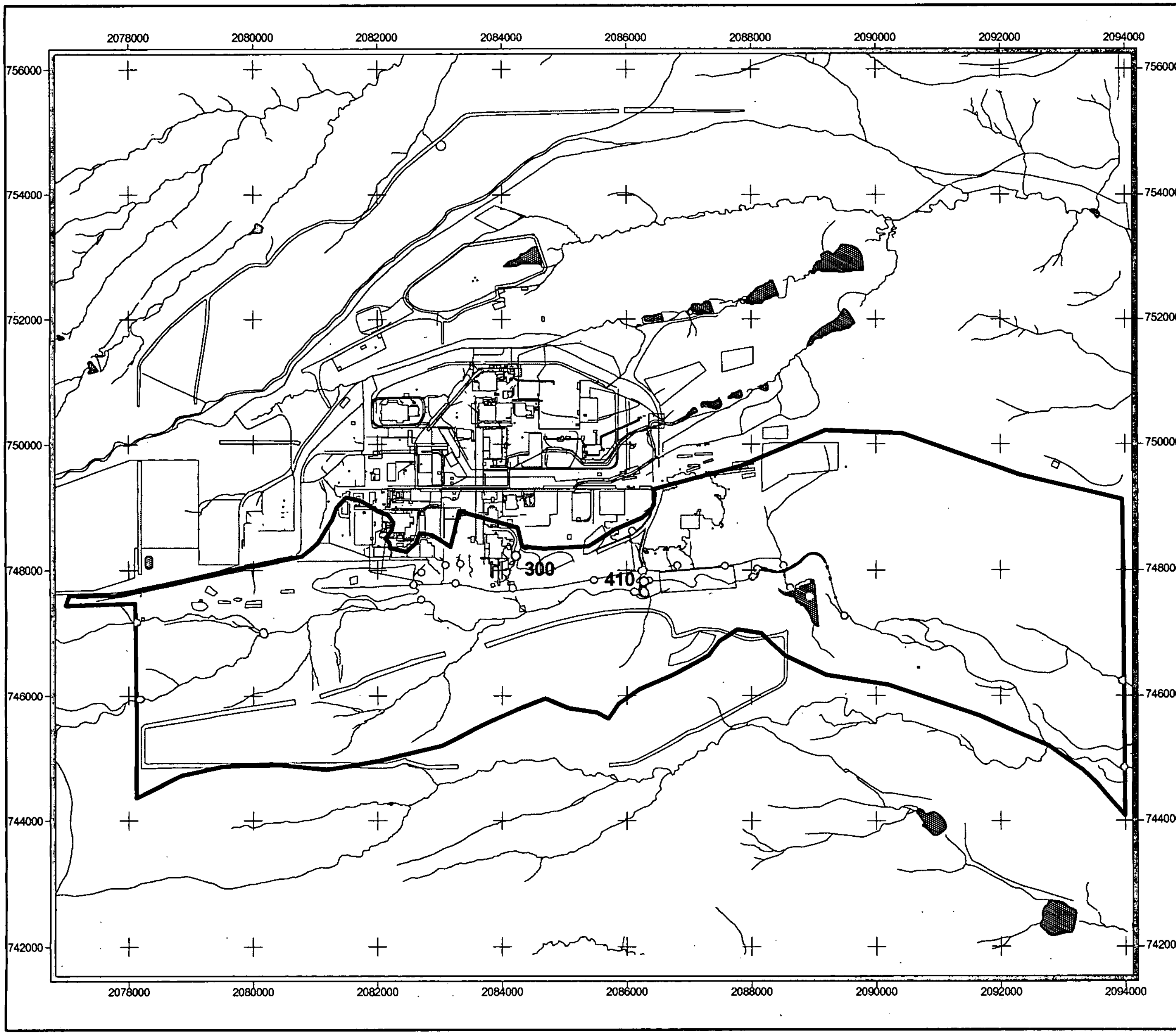

Figure C-8
Woman Creek AEU
Sediment Results
for Naphthalene

KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Detect
- Nondetect
- Stream
- Lake
- Woman Creek AEU
- IHSS/PAC/UBC

ESL = 176 ug/kg

DRAFT

Data Set: 12/15/04

N
W E
S

1000 0 1000 2000 Feet

Scale 1:28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
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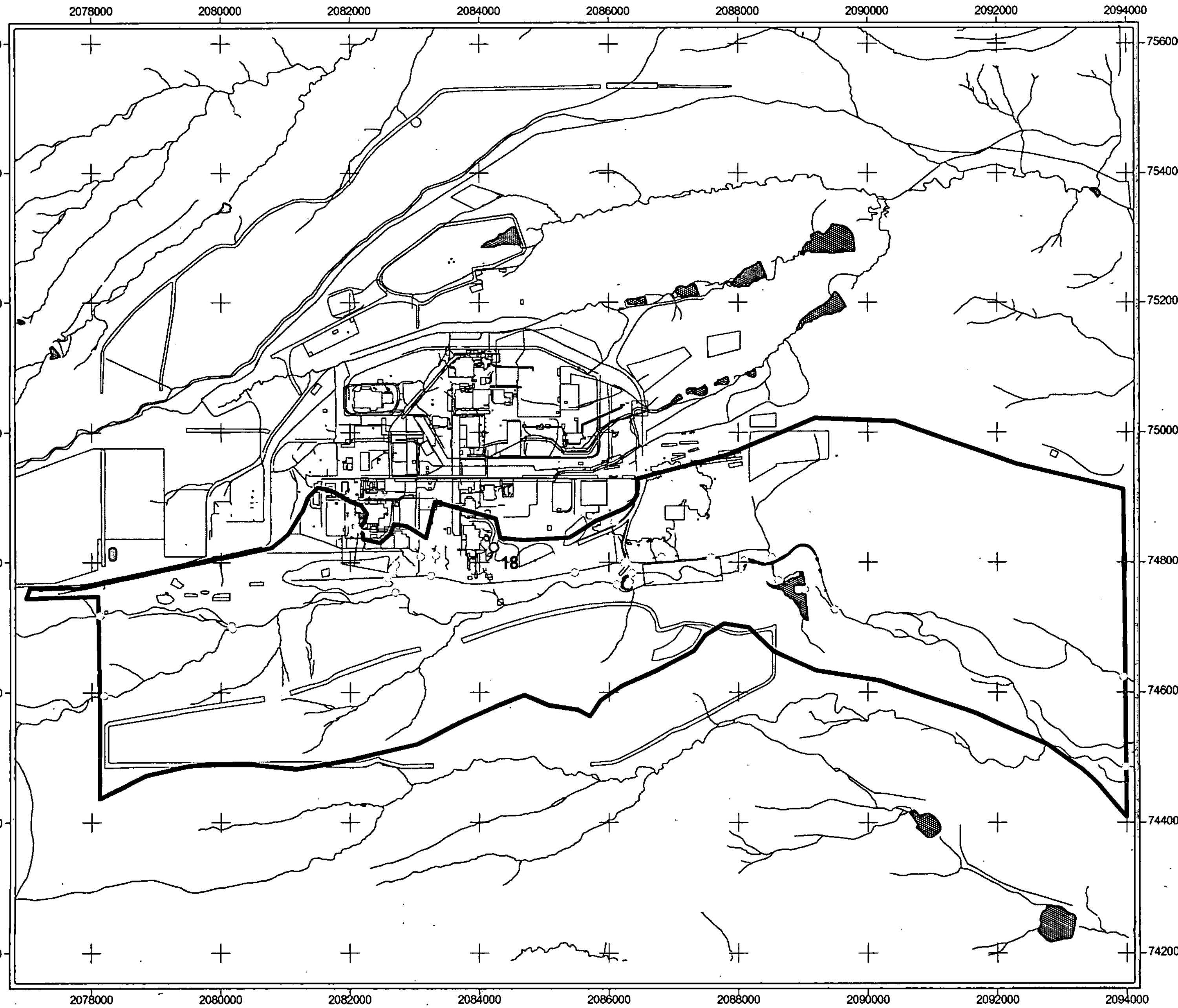

Figure C-9
Woman Creek AEU
Sediment Results
for 4,4'-DDT

KEY

1.0 Sample concentration (ug/kg)
Sampling location
O Detect
O Nondetect
Stream
Lake
Woman Creek AEU
IHSS/PAC/UBC

ESL = 4.16 ug/kg

DRAFT

Data Set: 12/15/04

N
W E
S

1000 0 1000 2000 Feet

Scale 1:28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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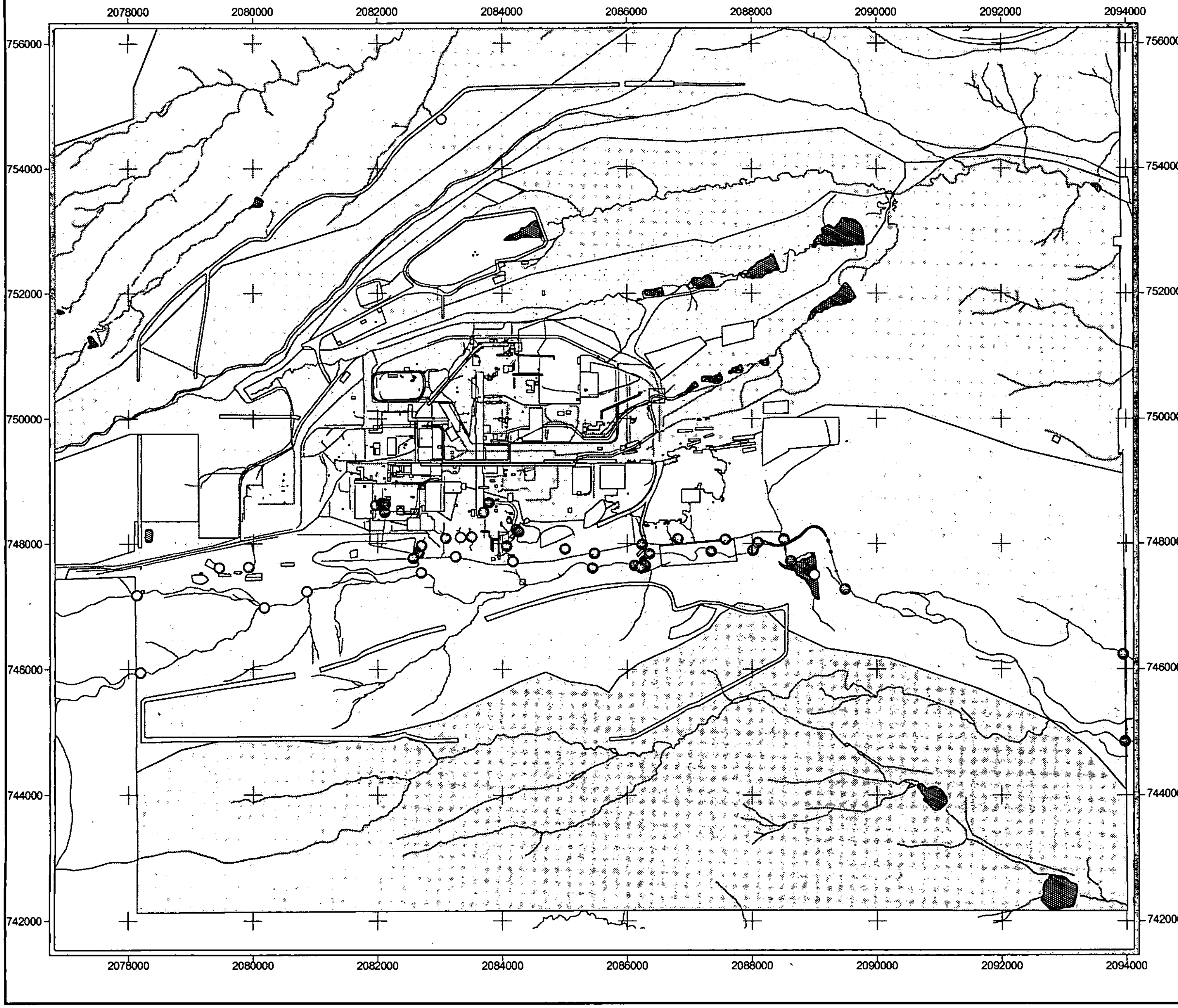

Figure C-10
Woman Creek AEU
Sediment Sampling Locations for Arsenic

KEY

Sampling location

- Moderate potential (>toxicity threshold = 33 mg/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>9.8 and <33 mg/kg)
- Low potential (<ESL = 9.8 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

N W E S

1000 0 1000 2000 Feet

Scale 1: 28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

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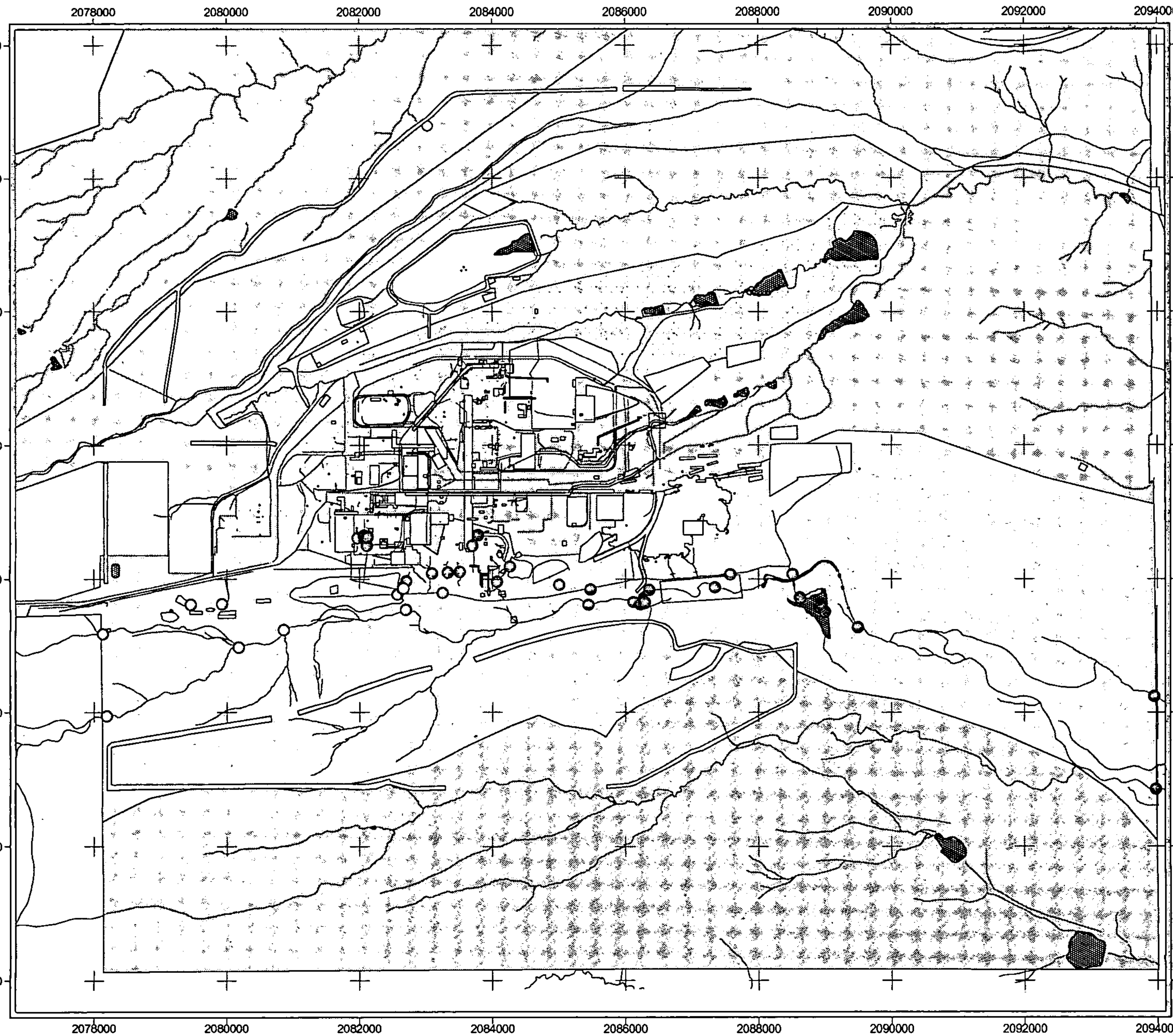

Figure C-11
Woman Creek AEU
Sediment Sampling Locations for
Chromium

KEY

Sampling location
- Moderate potential (>toxicity threshold = 111 mg/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>43.4 and <111 mg/kg)
- Low potential (<ESL = 43.4 mg/kg)
- Nondetect

- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

DRAFT

Data Set: 12/15/04

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Scale 1: 28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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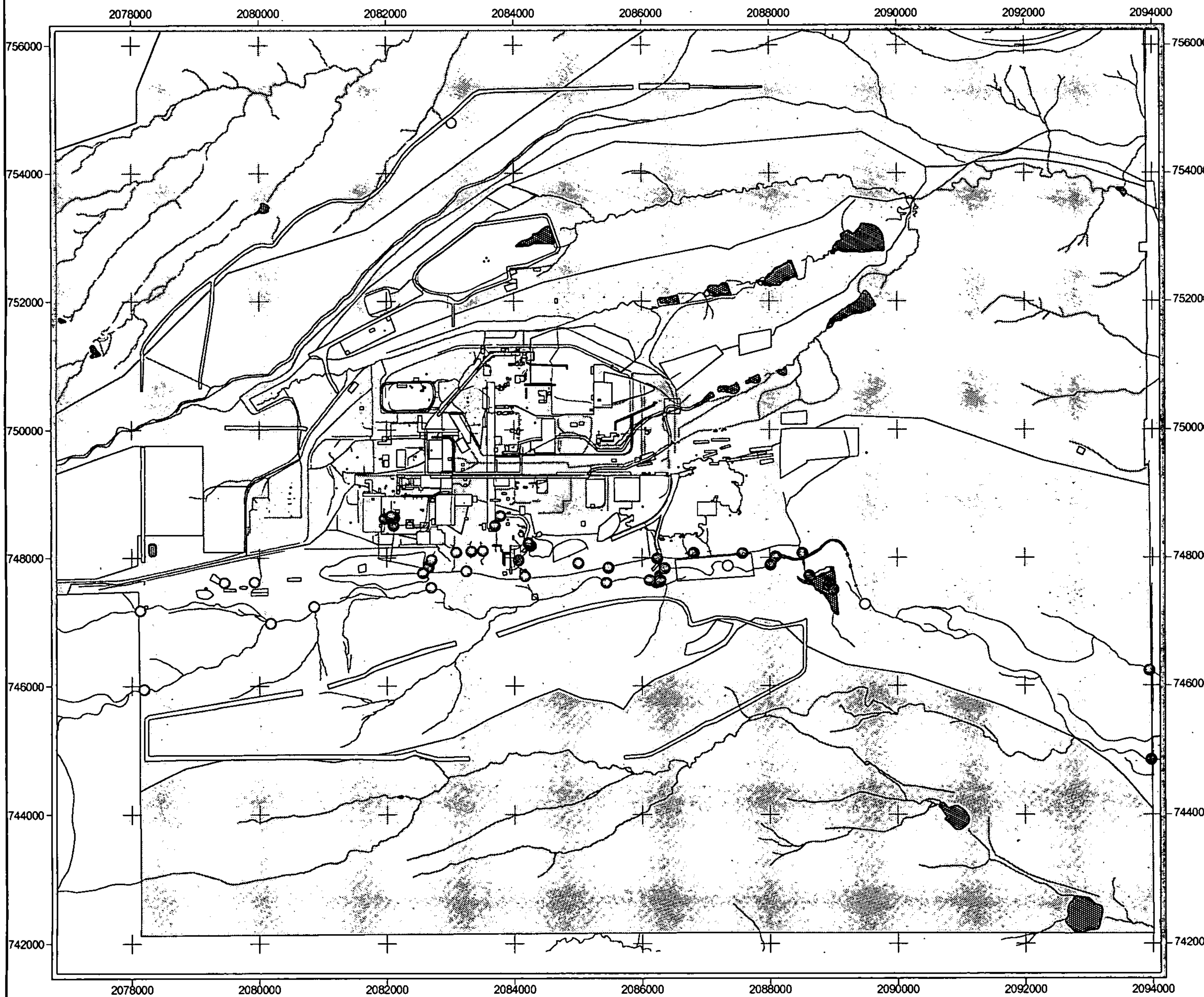

Figure C-12
Woman Creek AEU
Sediment Sampling Locations for Manganese

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,700 mg/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>630 and <1,700 mg/kg)
- Low potential (<ESL = 630 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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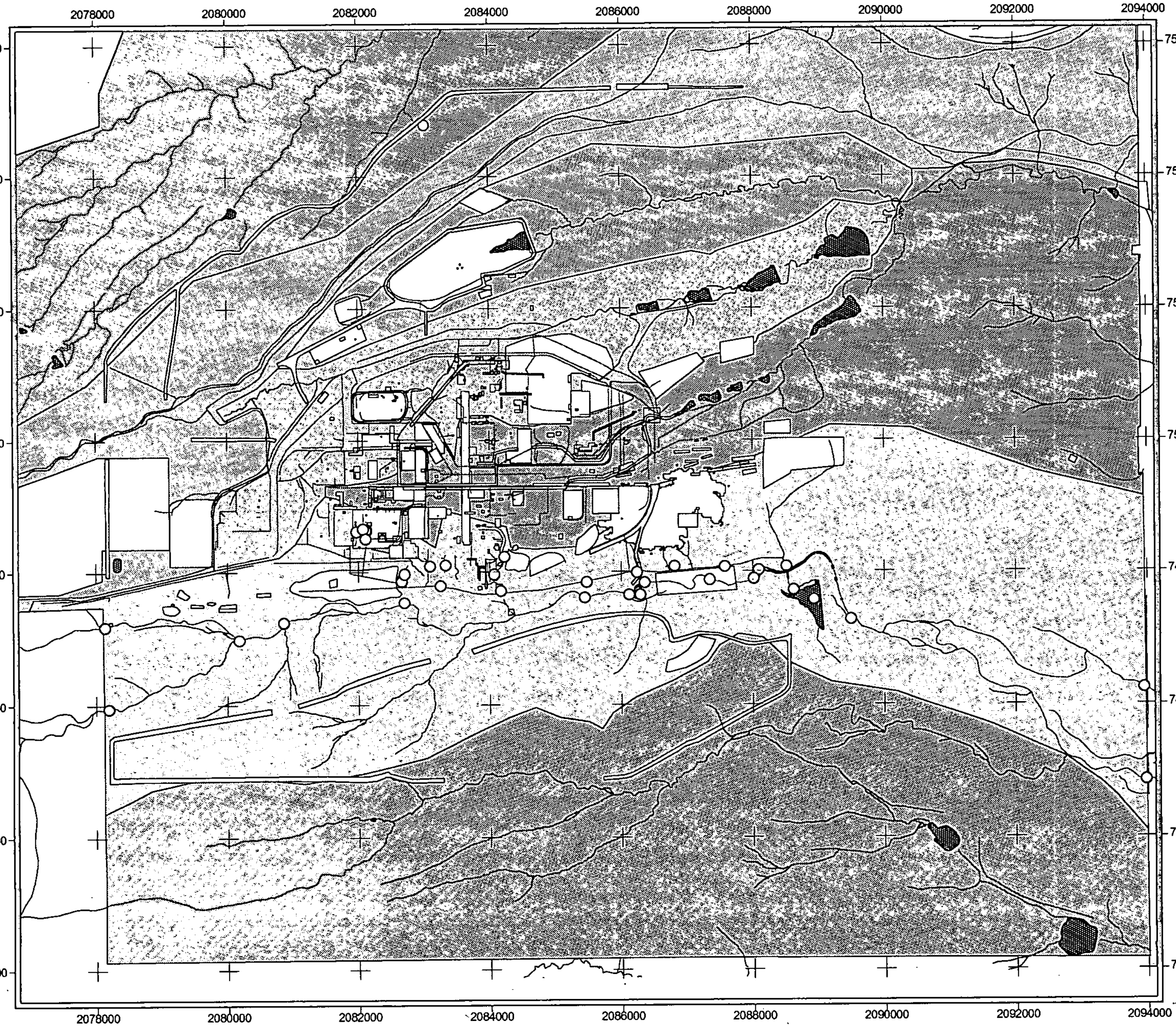

Figure C-13
Woman Creek AEU
Sediment Sampling Locations for Antimony

KEY

Sampling location

- Moderate potential (>toxicity threshold = 3.2 mg/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>2 and <3.2 mg/kg)
- Low potential (<ESL = 2 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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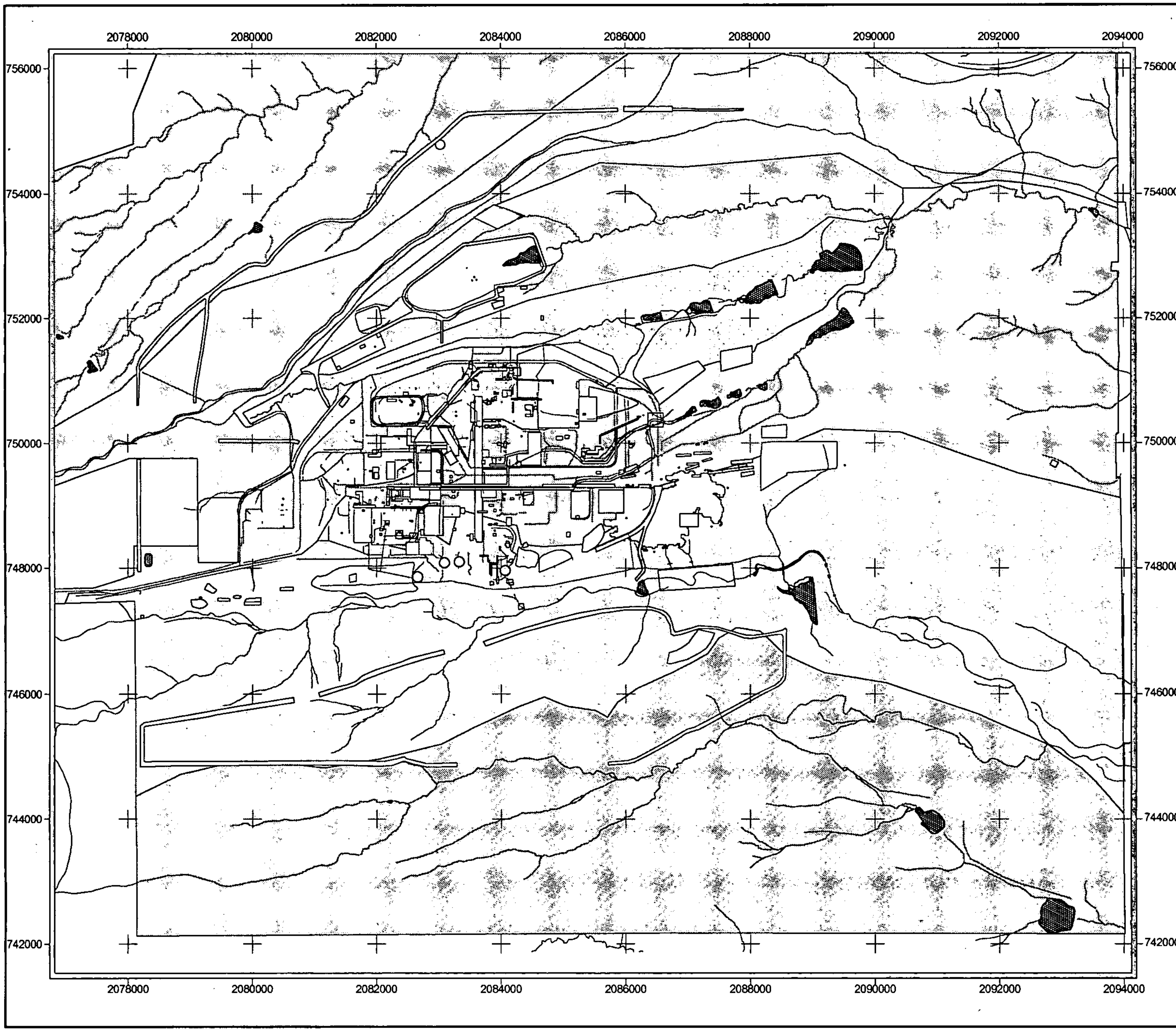

Figure C-14
Woman Creek AEU
Sediment Sampling Locations for Fluoride

KEY

Sampling location

- Moderate potential (>toxicity threshold = 7 mg/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>0.01 and <7 mg/kg)
- Low potential (<ESL = 0.0.1 mg/kg)
- Nondetect

- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

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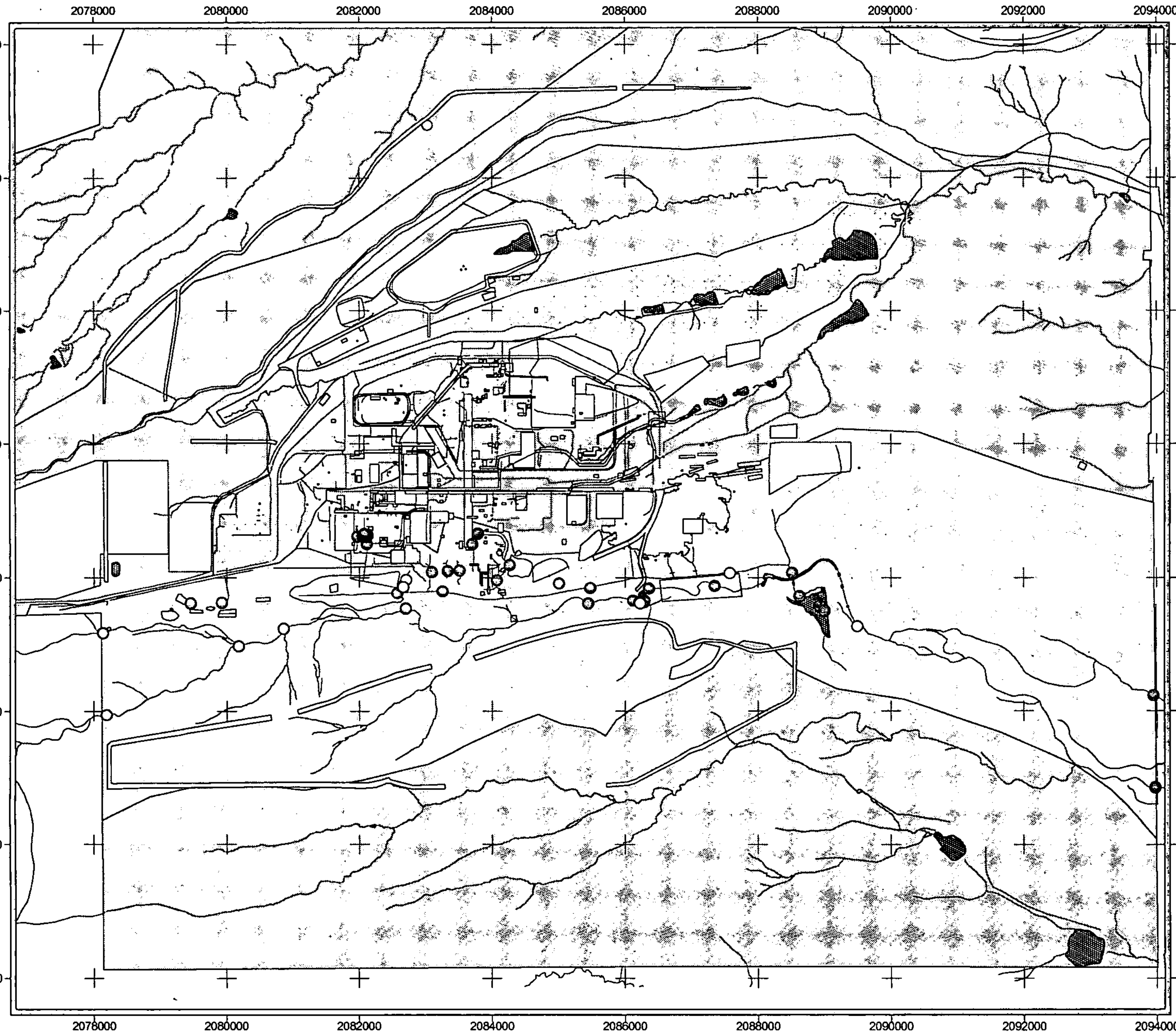

Figure C-15
Woman Creek AEU
Sediment Sampling Locations for Iron

KEY

Sampling location

- Moderate potential (>toxicity threshold = 280,000 mg/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>2000 and <280,000 mg/kg)
- Low potential (<ESL = 2000 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

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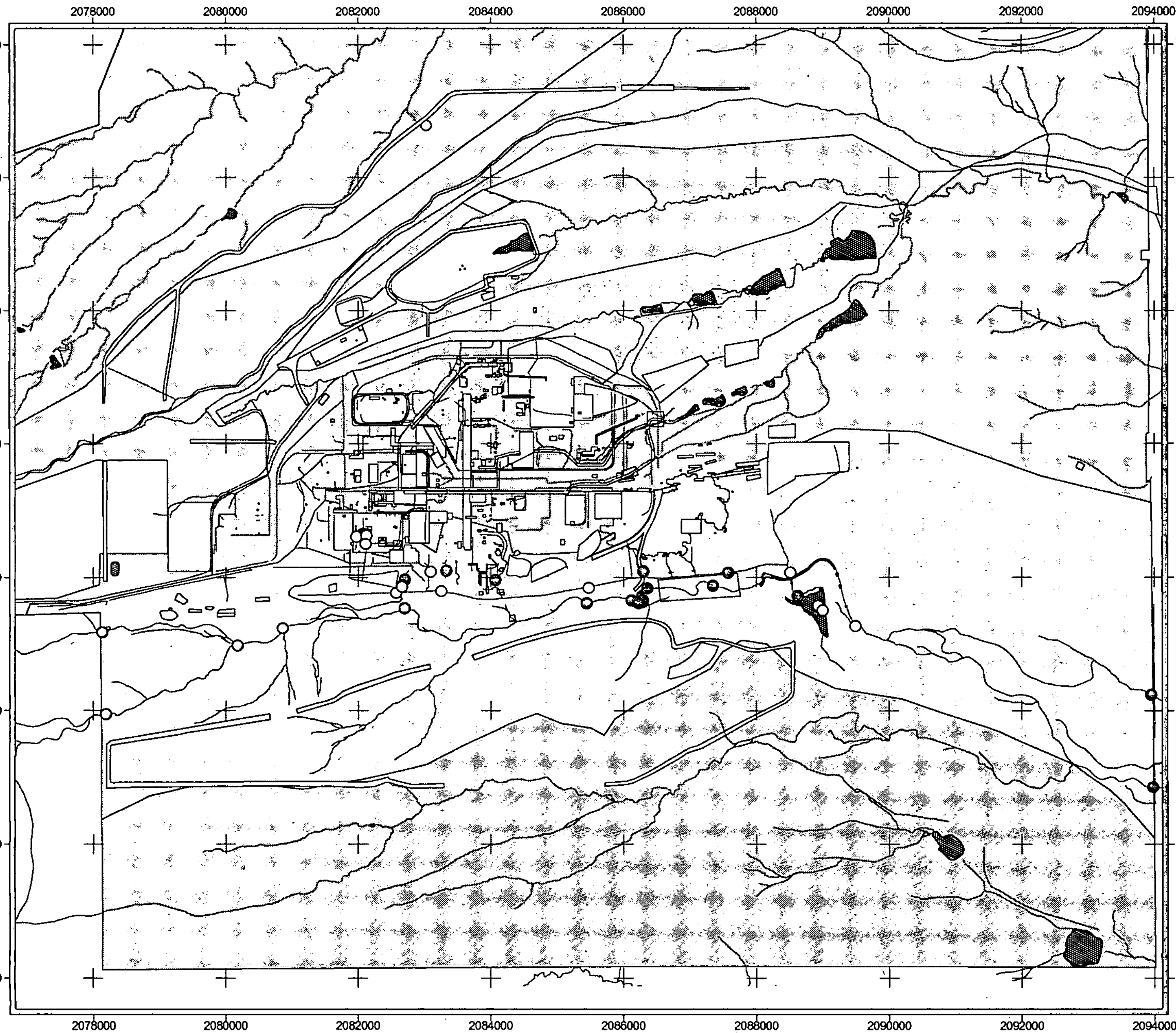

Figure C-16
Woman Creek AEU
Sediment Sampling Locations for Zinc

KEY

Sampling location

- Moderate potential (>toxicity threshold = 459 mg/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>121 and <459 mg/kg)
- Low potential (<ESL = 121 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

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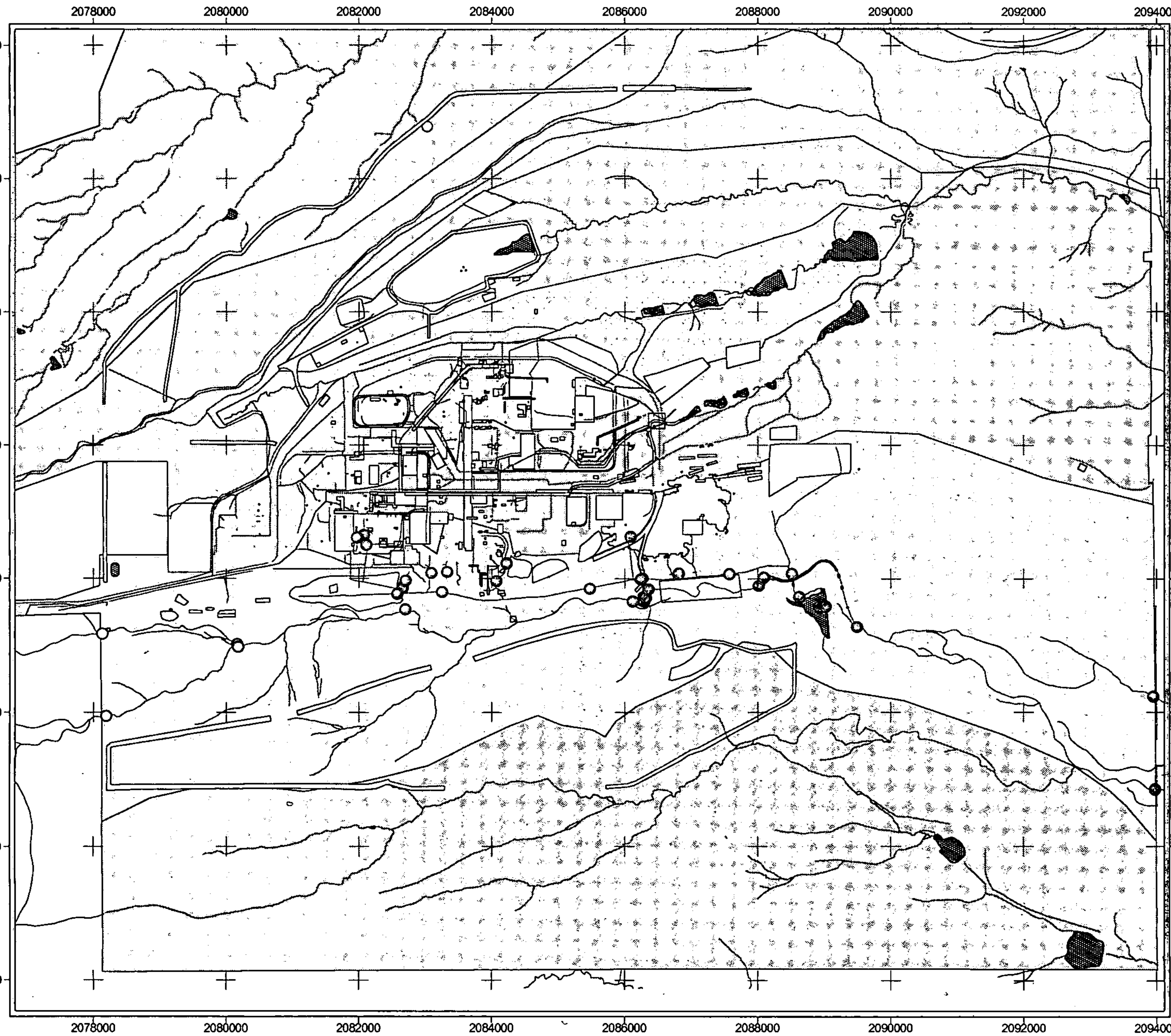

Figure C-17
Woman Creek AEU
Sediment Sampling Locations for Heptachlor

KEY

Sampling location

- Moderate potential (>toxicity threshold = 16 ug/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>0.132 and <16 ug/kg)
- Low potential (<ESL = 0.132 ug/kg)
- Nondetect

- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

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Scale 1: 28,000
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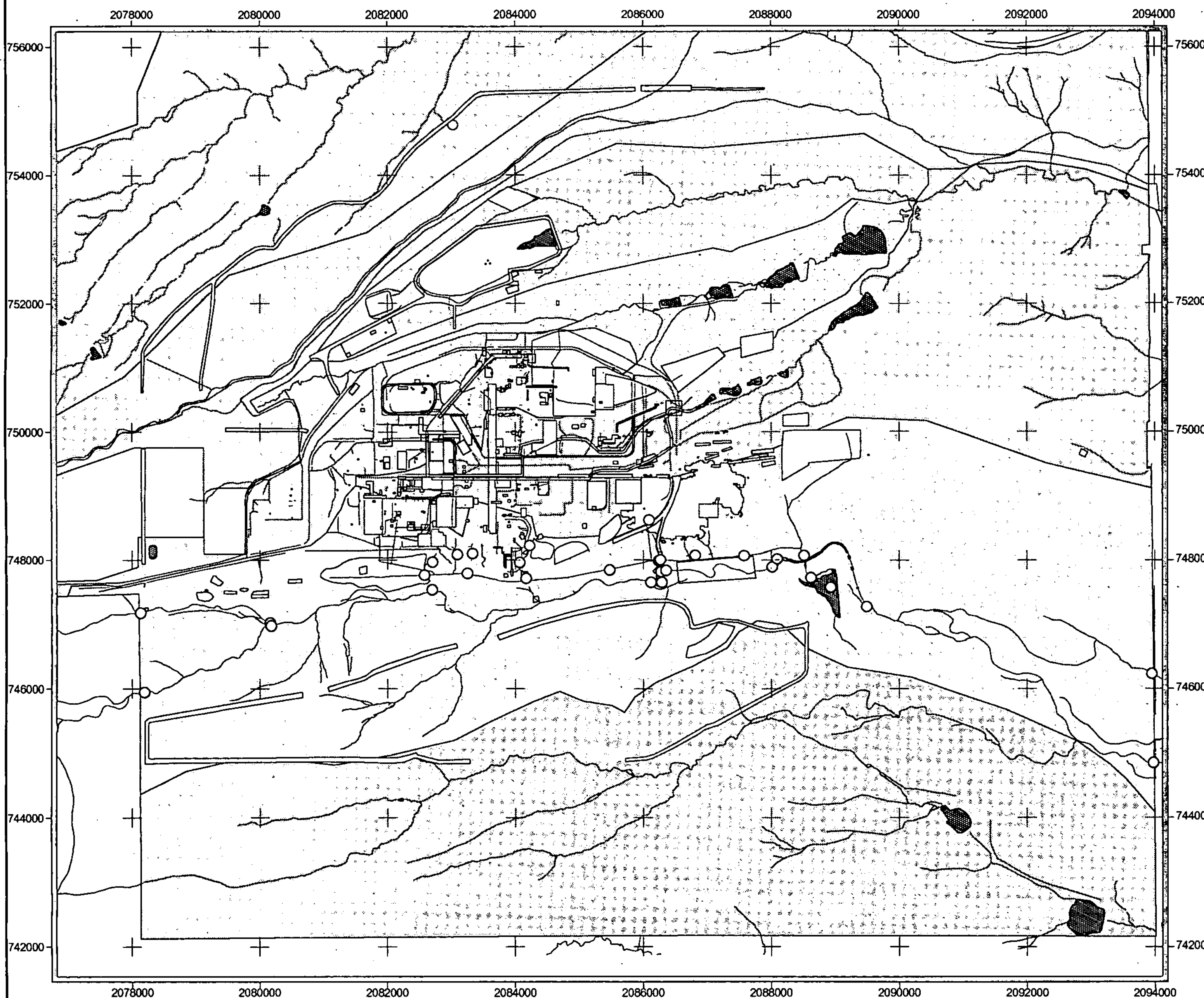

Figure C-18
Woman Creek AEU
Sediment Sampling Locations for
4-Methylphenol

KEY

Sampling location

- Moderate potential (>toxicity threshold = 670 ug/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>12.3 and <670 ug/kg)
- Low potential (<ESL = 12.3 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Scale 1: 28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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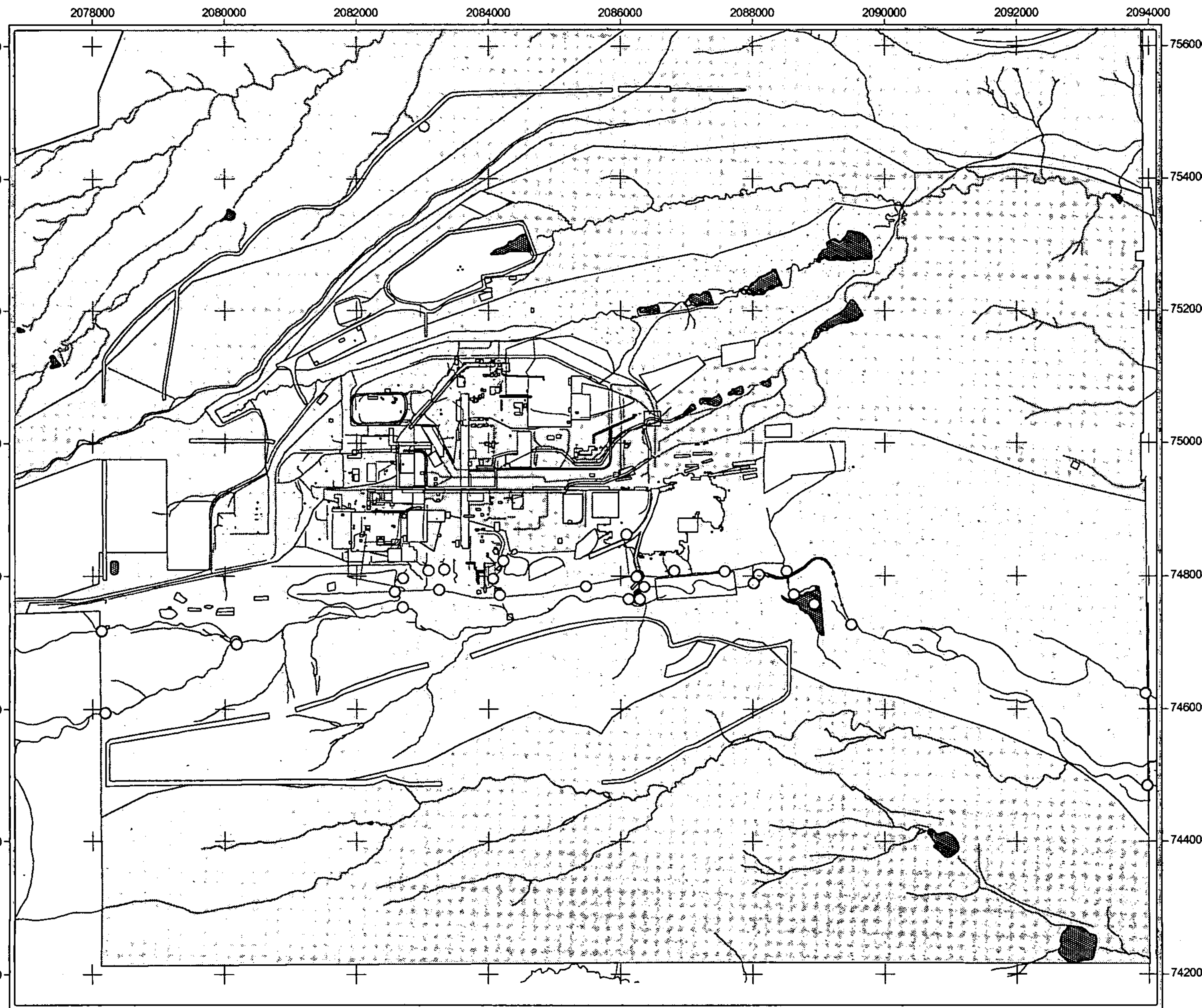

Figure C-19
Woman Creek AEU
Sediment Sampling Locations for Benzo(a)anthracene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,050 ug/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>108 and <1,050 ug/kg)
- Low potential (<ESL = 108 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Scale 1: 28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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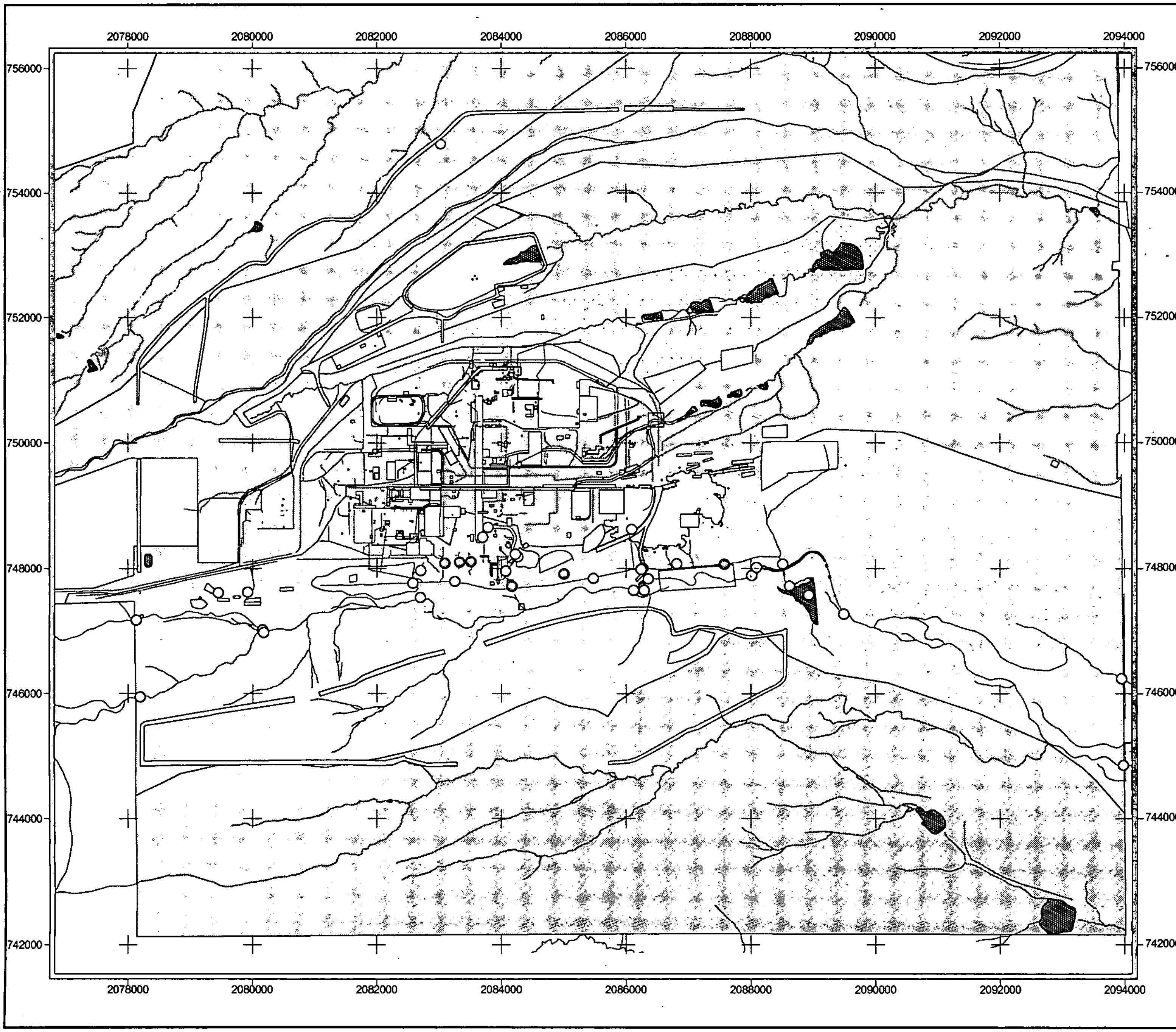

Figure C-20
Woman Creek AEU
Sediment Sampling Locations for
Benzo(a)pyrene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,450 ug/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>150 and <1,450 ug/kg)
- Low potential (<ESL = 150 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

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Scale 1: 28,000
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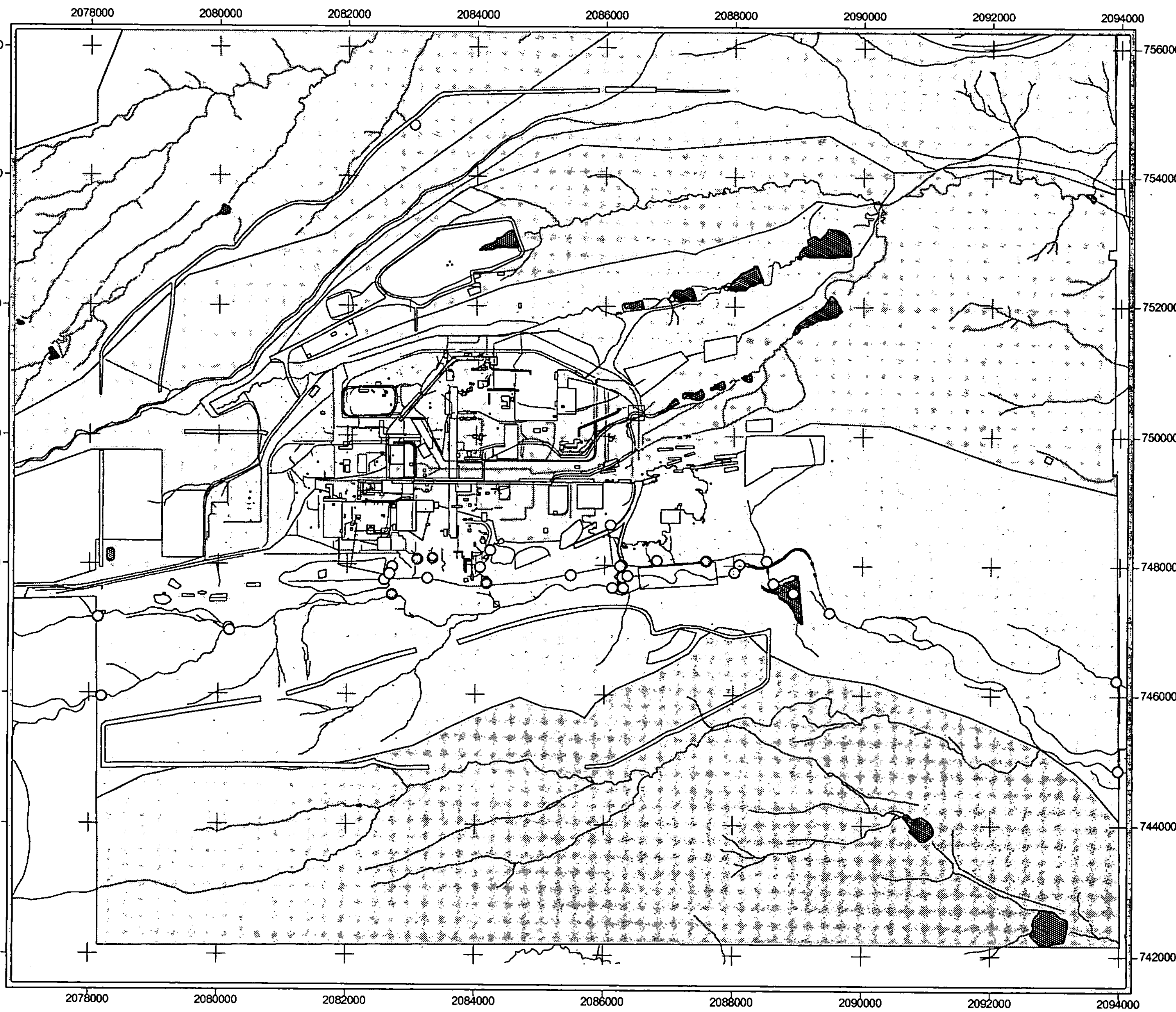

Figure C-21
Woman Creek AEU
Sediment Sampling Locations for
Chrysene

KEY

Sampling location

- Moderate potential (>toxicity threshold = 1,290 ug/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>166 and <1,290 ug/kg)
- Low potential (<ESL = 166 mg/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Scale 1:28,000
State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

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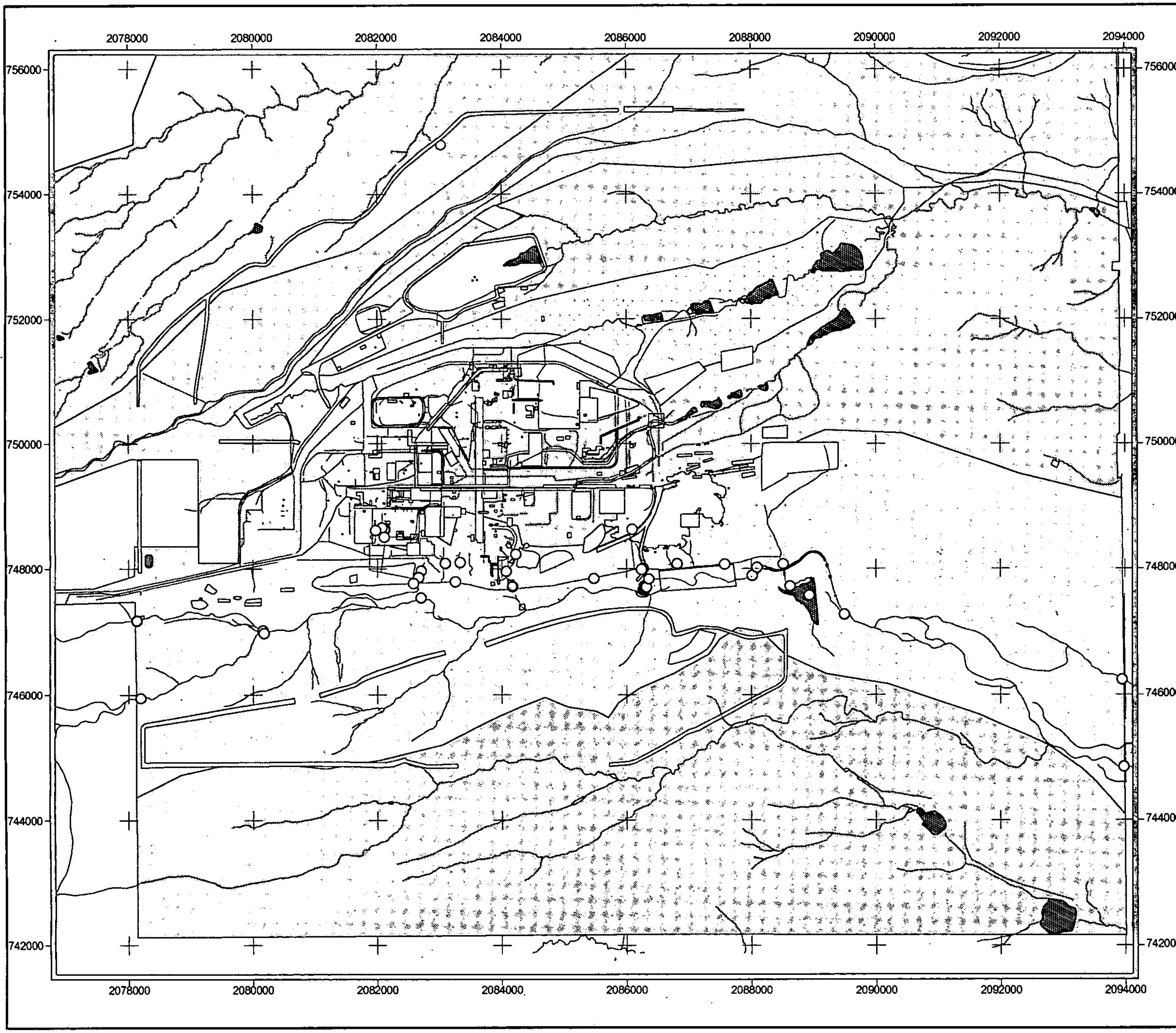

Figure C-22
Woman Creek AEU
Surface Sediment Sampling
Locations for PCB-1254

KEY

Sampling location

- Moderate potential (>toxicity threshold = 300 ug/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>60 and <300 ug/kg)
- Low potential (<ESL = 60 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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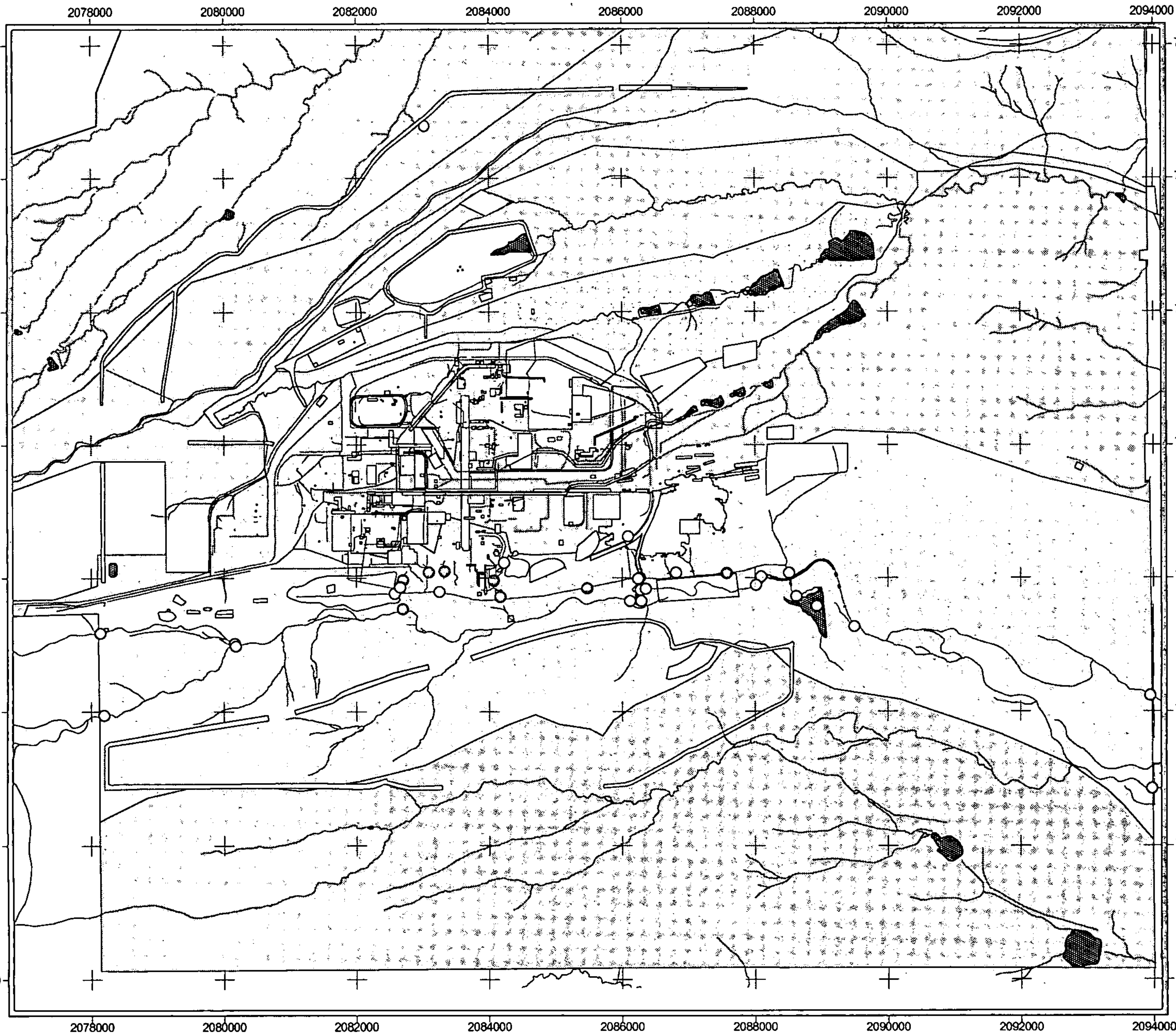

Figure C-23
Woman Creek AEU
Sediment Sampling Locations for
Phenanthrene

KEY

Sampling location
- Moderate potential (>toxicity threshold = 1,170 ug/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>204 and <1,170 ug/kg)
- Low potential (<ESL = 204 ug/kg)
- Nondetect

Stream
Lake or Pond
PAC
IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Data Set: 12/15/04

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Scale 1:28,000
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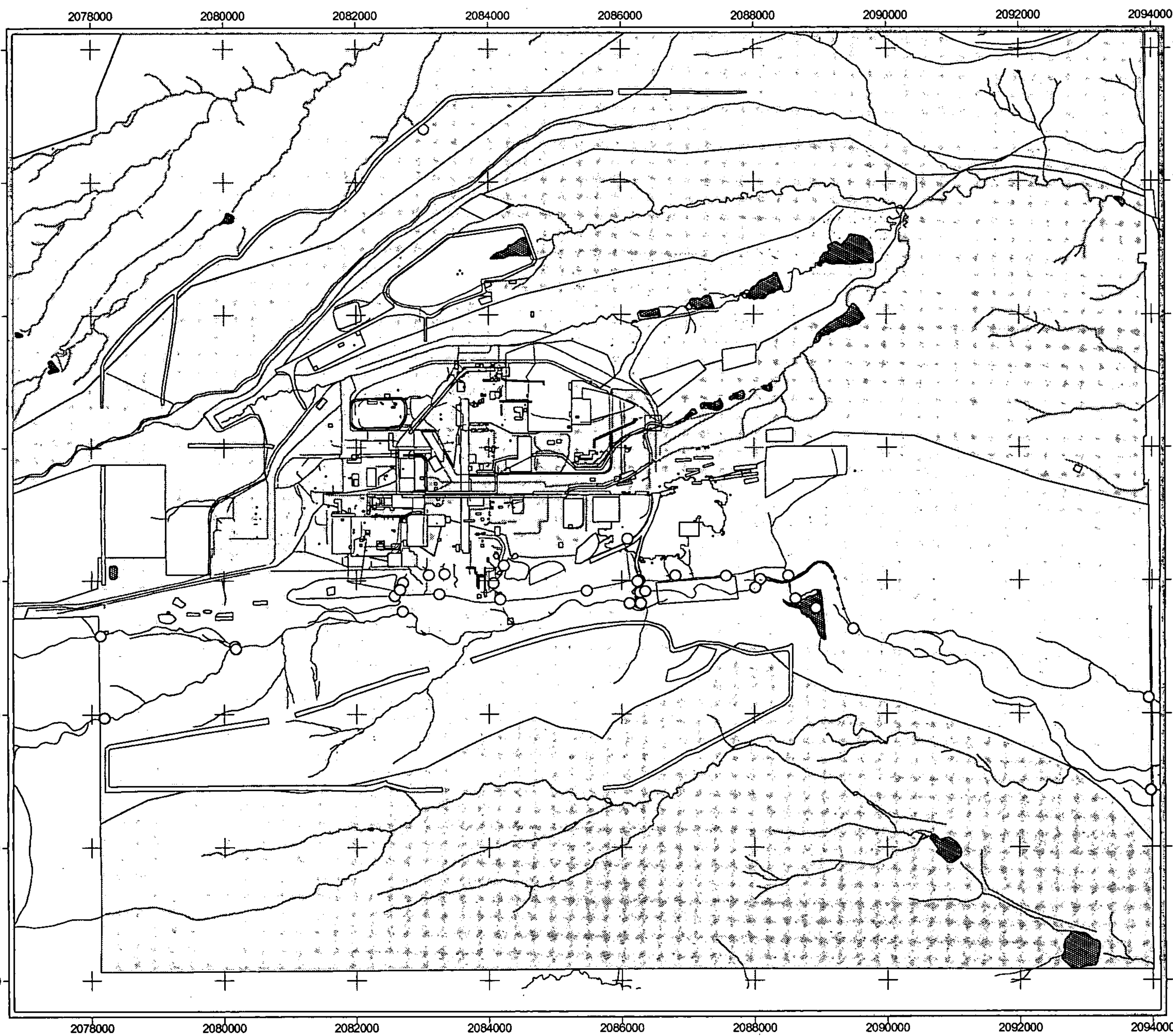

Figure C-24
Woman Creek AEU
Sediment Sampling Locations for Pyrene

KEY

Sampling location
- Moderate potential (>toxicity threshold = 1,520 ug/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>195 and <1,520 ug/kg)
- Low potential (<ESL = 195 ug/kg)
- Nondetect
- Stream
- Lake or Pond
- PAC
- IHSS

Aquatic EUs
- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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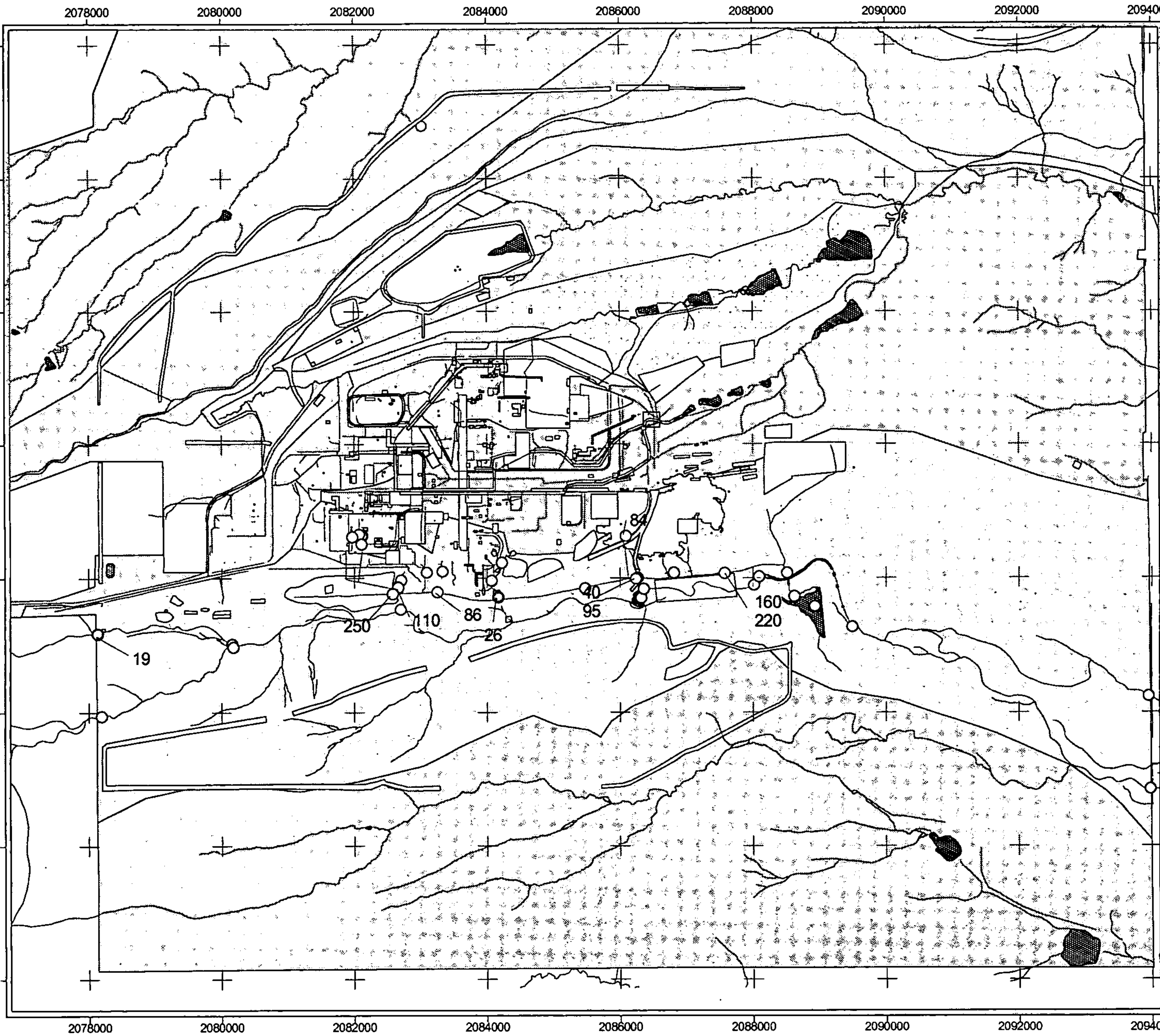

Figure C-25
Woman Creek AEU
Surface Sediment Sampling
Location Results for PCB-1254

KEY

1.0 Sample concentration (ug/kg)

Sampling location

- Moderate potential (>toxicity threshold = 300 ug/kg)
- Low to moderate potential (>ESL and < toxicity threshold) (>60 and <300 ug/kg)
- Low potential (<ESL = 60 ug/kg)
- Non-detect
- Stream
- Lake or pond
- PAC
- IHSS

Aquatic EUs

- McKay Ditch AEU
- No Name Gulch AEU
- North Walnut Creek AEU
- Rock Creek AEU
- South Walnut Creek AEU
- Southeast AEU
- Woman Creek AEU

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Attachment 1

Aquatic Ecosystem Health Assessment – Woman Creek Aquatic Exposure Unit

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ACRONYMS

AAI	Aquatic Associates, Inc.
ac-ft	acre-feet
AEU	Aquatic Exposure Unit
BZ	Buffer Zone
cfs	cubic feet per second
DOE	U.S. Department of Energy
ECOPC	ecological contaminant of potential concern
ERA	Ecological Risk Assessment
EU	Exposure Unit
HI	hazard index
HQ	hazard quotient
IA	Industrial Area
PAH	polycyclic aromatic hydrocarbon
PCOC	potential contaminant of concern
RFETS	Rocky Flats Environmental Technology Site
RFI/RI	RCRA Facility Investigation/Remedial Investigation
SID	South Interceptor Ditch
WQCC	Water Quality Control Commission
WWE	Wright Water Engineers

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AQUATIC ECOSYSTEM HEALTH

Woman Creek traverses the south side of the Rocky Flats Environmental Technology Site (RFETS), and captures runoff from the southern portion of the Industrial Area (IA), as well as the majority of the southern buffer zone (BZ). Several tributaries to Woman Creek exist within the RFETS boundaries and include, from north to south, the South Interceptor Ditch (SID), North Woman Creek, Owl Branch, and Antelope Springs. The hydrology in the Woman Creek tributaries is expected to remain unchanged between the historic and future configuration of RFETS with the exception of the SID, in which flows are anticipated to be reduced. Woman Creek flows through Pond C-1, which was reconfigured as a low-profile, flow-through structure in 2005. Woman Creek is isolated from IA surface runoff by the SID, which intercepts surface flow and diverts it to Pond C-2. Woman Creek is diverted around Pond C-2 via a concrete diversion wall and channel, rejoining the original Woman Creek channel downstream of Pond C-2.

Woman Creek is designated as stream segment 4a in the Big Dry Creek basin by the Colorado Water Quality Control Commission (WQCC). The mean annual discharge volume measured at the site boundary near Indiana Street is approximately 269 acre-feet (ac-ft) per year, with a peak flow of 80 cubic feet per second (cfs). Woman Creek flows into Woman Creek Reservoir after exiting RFETS.

Aquatic habitats within the Woman Creek Aquatic Exposure Unit (EU) (AEU) (WC AEU) are restricted to the headwaters of Woman Creek and its tributaries (that is, the area above Pond C-2). Intermittent stream flow alternates with areas of persistent flow within the headwaters. Intermittent segments contain isolated pools that provide important habitat for many aquatic species during the late summer and early fall when flow ceases. Persistent flows originate from seeps and springs and provide year-round aquatic habitats. Pond C-1 is the only pond associated with Woman Creek directly because Pond C-2 is hydrologically isolated from the creek and receives flows from the SID. The SID provides only marginal ephemeral habitats. These ephemeral habitats comprise a few small pools where water collects during storm events. These areas dry out quickly. Below Pond C-2, only one or two small pools remain most of the year in lower Woman Creek. The rest of this reach is dry the majority of the year.

Woman Creek retains a significant amount of stream habitat and holds the majority of RFETS fish species. Native fish species that reproduce within Woman Creek include white suckers (*Catostomus commersoni*), fathead minnows (*Pimephales promelas*), green sunfish (*Lepomis cyanellus*), stonerollers (*Capostoma anomalus*), and creek chubs (*Semotilus atromaculatus*). Two none-native fish species, golden shiners (*Notemigonus crysoleucas* and largemouth bass (*Micropterus salmoides*), also are found in the drainage.

Within Woman Creek, the most common aquatic macroinvertebrates are Oligochaetes (tubificid worms) (DOE 2003), larvae of the blackfly (Order *Diptera, Simulidae* sp.), midge (Order *Diptera, Chironomidae* sp), and mayfly (Order *Ephemeroptera*) (DOE 1995). Other species include caddisflies (Order *Trichoptera*), craneflies (*Tipulidae* ssp.), damselfly larvae (Order *Odonata*), and stonefly larvae (Order *Plecoptera*), as well as snails (Class *Gastropoda*) and amphipods (Order *Amphipoda*). Large macroinvertebrates,

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such as crayfish (Order *Decapoda,* Family *Astacidae*) and snails, are potentially important prey for other fish, waterfowl, and mammal species.

The health of aquatic life within the AEU can be potentially affected by contaminants associated with RFETS activities that were released into the EU, or by the limits of the habitat itself. The potential effects attributable to contaminants were evaluated using standard Ecological Risk Assessment (ERA) methods including the initial ecological contaminant of potential concern (ECOPC) identification phase. Additional steps involving the development of hazard quotients (HQs), and evaluation of the nature and extent of contaminant occurrence were also completed. These steps are referred to as the "risk estimation" and represent the first component of the risk characterization. This attachment references documented studies that describe the aquatic ecosystem health within Woman Creek. This information was obtained from previous investigations and is summarized to understand the holistic condition of the drainage.

Previous studies that characterized the aquatic ecosystem health were reviewed and summarized by source, as presented below.

Baseline Aquatic Biological Characterization (DOE 1992) – The benthic macroinvertebrate community is relatively rich and diverse. The most abundant and widespread groups overall in stream communities are the larvae of true flies (*Diptera*) and mayflies (*Ephemoptera*). The most common dipteran taxa are blackflies (*Simulidae*) and midges (*Chironomidae*). Both caenid and baetid mayflies are also common. Species richness for mayflies and caddisflies increase from headwater segments to the area east of Pond C-2, where flow in Woman Creek decreases (apparently due to loss to groundwater). Communities within the ponds are strongly dominated by midges and aquatic earthworms (*Oligochaeta*). Pond C-1 has a more developed aquatic plant community along the edge, supporting a more diverse assemblage of nektonic forms, including water striders (*Hemiptera Gerridae*) and water boatmen (*Hemiptera Corixidae*). Predatory dragonfly nymphs (*Odonota)* are present in the C-ponds, as are crayfish (*Astacidae*).

Fish species within the streams include the creek chub, stoneroller, fathead minnow, and green sunfish. Fish communities in the C-ponds are influenced by the presence of suitable substrates, vegetation and persistence of water. The most common species include the golden shiner, white sucker, and largemouth bass found in Pond C-1; however, creek chubs and stonerollers were observed frequently throughout the upper sections of Woman Creek. Golden shiners feed on a variety of small prey and algae and may themselves be important prey for larger fish or piscivorous birds because of the large populations they attain and their relatively large size. Aquatic vertebrates in Pond C-2 comprise fathead minnows and the aquatic form of tiger salamanders (*Ambystoma tigrinum*).

Final Phase 1 RFI/RI Report for Woman Creek. Appendix N: Ecological Risk Assessment for Woman Creek Watershed – Initial exposure screens for receptor species and source areas revealed ECOC's for more sedentary terrestrial species and aquatic receptors that spend most of their time in small areas. Radionuclides in sediment did not contribute to ecological risk in the aquatic environment. The tiered screening level hazard assessment of the Woman Creek watershed was characterized by relatively

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small HQs and hazard indices (HIs) indicating low ecological risk overall, and risk from surface water potential contaminants of concern (PCOCs) was limited to a small number of inorganic chemicals and was of low magnitude. Risk estimates were described separately for aquatic organisms and aquatic-feeding birds.

Risks to aquatic life were primarily due to polycyclic aromatic hydrocarbons (PAHs) in sediments. Results of analysis illustrate the conservative nature of the TRVs used in calculating the HQs and HIs. In most cases, toxicity was overestimated and could not be confirmed with other lines of evidence including ecological indices and bioassay test results. The importance of sediment contamination is unclear but does not appear to be the primary factor controlling benthic community structure.

ECOPCs from Woman Creek aquatic environments resulted in HQs greater than 1 for aquatic-feeding birds, including Aroclor-1254 in SID sediments, mercury in fish tissue, and antimony in sediments at the old landfill site. Risk to aquatic-feeding birds was negligible. Aroclor-1254 concentrations in sediment did not exceed risk-based criteria developed for sediments at RFETS. Mercury was detected in 2 of 24 fish samples from Pond C-1 and not detected in any fish samples from other areas. Risks were considered significant only if birds obtained all their food from Pond C-1. This assumption is unrealistic for aquatic-feeding birds.

Interim Report: Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, 2001-2002 (DOE 2003) – All of the streams at Rocky Flats are flow-limited (DOE 2003). Natural and anthropogenic (water management practices) are critical to the habitat, and highly influence the aquatic life. The measured macroinvertebrate community was rich and diverse, and comprised mainly of hardy and tolerant species. The dominant organisms were similar within each drainage, with oligochaetes being dominant in Woman Creek. Comparisons between the drainages showed that community structure and abundance were similar. The intermittent nature and lack of sustained stream flows was implicated as the major limiting factor for sustaining healthy and balanced macroinvertebrate communities.

SUMMARY

The Woman Creek drainage supports some the most diverse and varied aquatic communities on RFETS. Past studies provide a body of evidence that aquatic communities persist through time and are comparable to other healthy communities found on site and in other areas within the region (DOE 2003). Many sections of Woman Creek are ephemeral and provide only limited habitats. The presence of seeps and springs, including Antelope Springs, provides perennial segments in other portions of the creek. Given this fact, Woman Creek provides habitat for seven fish species and has viable populations of creek chubs and fathead minnows. Although the creek chubs and fathead minnows are tolerant of some water turbidity, their presence indicates good water quality. The presence of the central stoneroller in Woman Creek (DOE 1992, 2003) indicates clear water conditions and an even higher level of water quality and riffle/run stream habitats. Past reports support the idea that Woman Creek aquatic communities are healthy, albeit limited, and provide normal functions capable of sustaining rich and diverse aquatic life that comprise hardy and tolerant species adapted to the limiting environmental conditions found in this small stream.

REFERENCES

DOE, 1992, Baseline Biological Characterization of the Terrestrial and Aquatic Habitats at Rocky Flats Plant, Golden, Colorado.

DOE, 1995, Final Phase 1 RFI/RI Report, Woman Creek Priority Drainage, Operable Unit 5, Appendix N, Ecological Risk Assessment for Walnut Creek and Woman Creek Watersheds at the Rocky Flats Environmental Technology Site, Golden, Colorado, September

DOE, 2003, Results of the Aquatic Monitoring Program in Streams at the Rocky Flats Site, 2001-2002, Prepared for DOE, Rocky Flats Field Office, Golden, Colorado.

Attachment 2

Toxicity Thresholds – Woman Creek Aquatic Exposure Unit

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ACRONYMS

AETA	apparent effect threshold approach sediment quality value, *Hyallela azteca,* dry weight
CB-PEC	consensus based – probable effects concentration
COS	classification of sediment as slightly polluted
CRA	Comprehensive Risk Assessment
Crit	criterion, dry weight
ECOPC	ecological contaminant of potential concern
EPA	Environmental Protection Agency
ERL	effect range low
ERM	effect range median
ESL	ecological screening level
ETV	ecotoxicological value, dry weight at 1% organic content
HQ	hazard quotient
LOAEL	lowest observed adverse effect level
μg/kg	micrograms per kilogram (may be found as ug/kg)
mg/kg	milligrams per kilogram
NIPHEP	National Institute of Public Health and Environmental Protection
NYSDEC	New York State Department of Environmental Conservation
PAH	polycyclic aromatic hydrocarbons
PCB	polychlorinated biphenyl
PEC	probable effect concentration
PEL	probable effect level
SCV	secondary chronic value
SQA	sediment quality advisory level at 1% organic carbon, guideline
SQC-MET	sediment quality criterion, minimal effect threshold, dry weight
SQC-TET	sediment quality criterion, toxic effect threshold, dry weight
SQG	sediment quality guideline
TEC	threshold effect concentration
TEL	threshold effect level
TNRCC	Texas Natural Resource Conservation Commission

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TOXICITY THRESHOLDS DISCUSSION

A set of toxicity thresholds were selected for each ecological contaminant of potential concern (ECOPC). The sediment ecological screening levels (ESLs) from the ECOPC identification process in the Comprehensive Risk Assessment (CRA) Methodology were used in this assessment, along with toxicity thresholds representative of a lowest observed adverse effect level (LOAEL) where available, or similar. Use of these two values for each ECOPC brackets the estimated risk using the hazard quotient (HQ) approach. A description of the thresholds for each ECOPC is provided below. A summary of the thresholds is provided in Table 1.

The endpoints for the sediment thresholds vary. In general, the median observed threshold from available studies was chosen because it represents a conservative, yet appropriate threshold. Compared to the ranges reported within Table 1, these values represent a central tendency measure. A description of the endpoints, as identified by the investigative study from where they were drawn, is provided below.

> MacDonald et al. 2000 – Numerical sediment quality guidelines (SQGs) were compiled and evaluated. A set of comparable SQGs were identified for certain inorganic and organic chemicals. For each chemical, two SQGs were identified: (1) a threshold effect concentration (TEC), and (2) a probable effect concentration (PEC). The TECs were determined to provide a value when there was an absence of sediment toxicity, whereas the PECs are values correlating to sediment toxicity. Based on results of the study, the incidence of sediment toxicity was generally low at contaminant concentrations below the TEC, while the PEC defined concentrations above which adverse effects are likely to occur. Because this study represents a culmination of numerous studies with combined endpoints for a suite of chemicals, the PEC was used for the HQ evaluation.

> Ingersoll et al. 1996 – Sediment effect concentrations were developed for a suite of chemicals based upon laboratory data on the toxicity of contaminants associated with field-collected sediment to the amphipod *Hyallela azteca* and midge *Chironomus riarius*. The sediment effect concentrations are defined as the concentrations of individual contaminants in sediment below which toxicity is rarely observed and above which toxicity is frequently observed. Three types were calculated from the data: (1) effect range low (ERL) and effect range median (ERM), (2) threshold effect level (TEL) and probable effect level (PEL), and (3) no effect concentration. For purposes of this risk characterization, the available ERL or ERM values were used for the HQ evaluation. The ERL represents the chemical concentration below which adverse effects would be rarely observed. The ERL value represents the lower 10^{th} percentile concentration associated with observations of biological effects. According to this method, concentrations below the ERLs should rarely be associated with adverse effects (EPA 1996). The ERM represents the chemical concentration above which adverse effects would frequently occur.

Table 1
Toxicity Thresholds for Sediment ECOPCs

ECOPC	Unit	Reported Range of Tox. Thresholds	Selected Toxicity Threshold[a]	Endpoint	Reference
Inorganics					
Aluminum	mg/kg	15900 – 58000	58000	ERM	Ingersoll et al. 1996
Antimony	mg/kg	2 – 500	3.2	SLCA	NYSDEC 1994
Arsenic	mg/kg	3 – 150	33	CB-PEC	MacDonald et al. 2000
Barium	mg/kg	20 – 500	287	SQG	TNRCC 1996
Cadmium	mg/kg	0.2 – 30	4.98	CB-PEC	MacDonald et al. 2000
Chromium	mg/kg	6.25 – 600	111	CB-PEC	MacDonald et al. 2000
Cobalt	mg/kg		50	CDM	OMOE 1987
Copper	mg/kg	8.4 – 840	149	CB-PEC	MacDonald et al. 2000
Fluoride	mg/kg	0.01 – 9.6	7	CT	Bolton et al. 1985
Iron	mg/kg	20000 – 290000	280000	ERM	Ingersoll et al. 1996
Lead	mg/kg	23 – 720	128	CB-PEC	MacDonald et al. 2000
Manganese	mg/kg	300 – 1800	1700	ERM	Ingersoll et al. 1996
Mercury	mg/kg	0.1 – 15	1.06	CB-PEC	MacDonald et al. 2000
Nickel	mg/kg	5 – 100	48.6	CB-PEC	MacDonald et al. 2000
Selenium	mg/kg	5 – 5	5	Crit	Nagpal et al. 1995
Silver	mg/kg	0.5 - 4.5	1.6	SQG	TNRCC 1996
Zinc	mg/kg	50 – 3200	459	CB-PEC	MacDonald et al. 2000
Organics					
1,2,4-Trimethylbenzene	ug/kg		9200	SQA	EPA 1997
Dichlorobenzene	ug/kg		340	SQA	EPA 1997
Trichlorophenol	ug/kg		340	SQA	EPA 1997
2-Butanone	ug/kg		270	SCV	Jones et al. 1997
2-Methylnaphthalene	ug/kg	20 – 201	201	PEL	Environment Canada 1999
4-Methylphenol	ug/kg		670	WS-SQS	Ginn and Pastorak 1992
Acenaphthene	ug/kg	6.71 – 100000	1300	SQA	EPA 1997
Acenaphthylene	ug/kg	5.87 – 6000	1900	AETA	Cubbage et al. 1997
Aldrin	ug/kg	0.6 – 84	5.3	CT	Bolton et al. 1985
Ammonia	ug/kg	100 – 930	340	AETA	Cubbage et al. 1997
Anthracene	ug/kg	6.8 – 41000	845	CB-PEC	MacDonald et al. 2000
Aroclor-1016	ug/kg	7 – 530	100	SQC-MET	MENVIQ/EC 1992
Aroclor-1242	ug/kg	100 – 100	100	AETA	Cubbage et al. 1997
Aroclor-1248	ug/kg	21 – 5100	50	SQC-MET	MENVIQ/EC 1992
Aroclor-1254	ug/kg	7.3 – 604	60	SQC-TET	MacDonald et al. 2000
Aroclor-1260	ug/kg	5 – 240	5	SQC-TET	MacDonald et al. 2000
Atrazine	ug/kg		0.3	ETV	Stortelder et al. 1989
Benzo(a)anthracene	ug/kg		1050	CB-PEC	MacDonald et al. 2000
Benzo(a)pyrene	ug/kg	9.6 – 450000	470	CB-PEC	Ingersoll et al. 1996
Benzo(b,k)fluoranthene	ug/kg	27 – 37	37	ERM	Ingersoll et al. 1996
Benzo(g,h,i)perylene	ug/kg	10.4 – 21000	280	ERM	Ingersoll et al. 1996
Benzo(k)fluoranthene	ug/kg	2.6 – 1250000	750	COS	NIPHEP 1989
Benzofluoranthenes	ug/kg	300 – 34000	2000	AETA	Cubbage et al. 1997
Benzyl Alcohol	ug/kg		57	SQA	Ginn and Pastorak 1992

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ECOPC	Unit	Reported Range of Tox. Thresholds	Selected Toxicity Threshold[a]	Endpoint	Reference
Bis(2-ethylhexyl)phthalate	ug/kg	19.95 – 1197	640	AETA	Ingersoll et al. 1996
Butylbenzylphthalate	ug/kg	11000 – 500000	11000	SQA	EPA 1997
Carbazole	ug/kg	140 -1800	1600	AETA	Cubbage et al. 1997
Chlordane	ug/kg	0.3 – 60	17.60	CB-PEC	MacDonald et al. 2000
Chloroform	ug/kg	0.4 – 0.4	0.4	ETV	Stortelder et al. 1989
Chrysene	ug/kg	8.6 – 11500	1290	CB-PEC	MacDonald et al. 2000
DDD	ug/kg	4 – 60	28.00	CB-PEC	MacDonald et al. 2000
DDE	ug/kg	1 – 190	31.30	CB-PEC	MacDonald et al. 2000
DDT	ug/kg	6 – 11000	62.90	CB-PEC	MacDonald et al. 2000
Dibenz(a,h)anthracene	ug/kg	5 – 3500	230	AETA	Ingersoll et al. 1996
Dibenzofuran	ug/kg	2000 – 32000	24000	AETA	Ingersoll et al. 1996
Dichlorobenzene	ug/kg	32 – 1200	340	SQA	EPA 1997
Dichlorofluoromethane	ug/kg		52.56	SQA	EPA 1997
Dieldrin	ug/kg	0.1 – 910	61.80	CB-PEC	MacDonald et al. 2000
Di-n-butylphthalate	ug/kg		42	AETA	Ingersoll et al. 1996
Endrin	ug/kg		207.00	CB-PEC	MacDonald et al. 2000
Ethylbenzene	ug/kg	96 – 4800	4800	SQA	EPA 1997
Fluoranthene	ug/kg	20 – 130000	2230	CB-PEC	MacDonald et al. 2000
Fluorene	ug/kg		536	CB-PEC	MacDonald et al. 2000
Heptachlor epoxide	ug/kg		16.00	CB-PEC	MacDonald et al. 2000
Indeno(1,2,3-cd)pyrene	ug/kg	10.4 – 6000000	250	ERM	Ingersoll et al. 1996
Lindane	ug/kg		4.99	CB-PEC	MacDonald et al. 2000
Methylene chloride	ug/kg	500 – 500	500	CT	Bolton et al. 1985
Naphthalene	ug/kg	10 – 140000	561	CB-PEC	MacDonald et al. 2000
Phenanthrene	ug/kg	6.8 – 210000	1170	CB-PEC	MacDonald et al. 2000
Pyrene	ug/kg	7.6 – 85000	1520	CB-PEC	MacDonald et al. 2000
Tetrachloroethane	ug/kg	2.2 – 1600	1600	SQA	EPA 1997
Total DDTs	ug/kg		572.00	CB-PEC	MacDonald et al. 2000
Total PAHs	ug/kg	200 – 700000	22800.00	CB-PEC	MacDonald et al. 2000
Total PCBs	ug/kg	2.0 – 40000	676.00	CB-PEC	MacDonald et al. 2000

[a] The hierarch of use of the toxicity thresholds was as follows: MacDonald et al. 2000 as a preference; others (EPA 1997, Ingersoll et al. 1996; etc.) have no preference compared to each other. The best available, most appropriate value is reported in these columns.

New York State Department of Environmental Conservation (NYSDEC) 1994 – The value for antimony was derived from this study and represents the criterion; lowest effect level in dry weight.

Texas Natural Resource Conservation Commission (TNRCC) 1996 – The value for barium was derived from this study and represents the SQG of 85th percentile level in reservoirs, dry weight.

Bolton et al. 1985 – The values for fluoride and heptachlor were derived from this study. The values represent the chronic equilibrium partition derived threshold at 1% organic carbon.

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MENVIQ/EC 1992 – The value for Aroclor-1254 was derived from this study and represents the sediment quality criterion, toxic effect threshold at 1% organic carbon.

Jones et al. 1997 – This study provides a compilation of available sediment toxicity thresholds and various approaches for their development. The value obtained from this guidance for 4-methylphenol represents the Washington State Sediment Quality Standards for Ionizable Organic Compounds (original source: Ginn and Pastorak 1992). The guidance recommends these values be used cautiously because they are site-specific. The values provide an indication of the magnitude of contamination.

National Institute of Public Health and Environmental Protection (NIPHEP 1989 – The value for benzo(k)fluoranthene was derived from this study and represents the recommended directive for classification of freshwater and dredged sediments as being slightly polluted.

REFERENCES

Bolton, H.S., R.J. Breteler, B.W. Vigon, J.A. Scanlon, and S.L. Clark, 1985, National Perspective on Sediment Quality, Battelle, Prepared for EPA Contract No. 68-01-6986, Washington Environmental Program Office, Washington, D.C.

Cubbage, J., D. Batts, and S. Breidenbach, 1997, Creation and Analysis of Freshwater Sediment Quality Values in Washington State, Publication No. 97-323a, Washington State Department of Ecology, Olympia, Washington.

Environment Canada, 1999, Canadian Water Quality Guidelines, Guidelines and Standards Division, Hull, Quebec (Document obtained from: http://www.ec.gs.ca/ceqg-rcqe/water.htm).

EPA, 1996 as cited within Jones et al. 1997, Calculation and Evaluation of Sediment Effect Concentrations for the Amphipod *Hyallela azteca* and the Midge *Chironomus riparius*, EPA 905-R96-008, Great Lakes national Program Office, Chicago, Illinois.

EPA, 1997, The Incidence and Severity of Sediment Contamination in Surface Waters of the U.S.: Volume 1: National Sediment Quality Survey, USEPA 823-R-97-006, Office of Science and Technology, Washington, D.C.

Ginn, T.C. and R.A. Pastorak, 1992, Assessment and Management of Contaminated Sediments in Puget Sound, pp. 371-401 in Sediment Toxicity Assessment, ed. G.A. Burton, Jr., Lewis Publishers, Boca Raton, Florida.

Ingersoll, C.G., P.S. Haverland, E.L. Brunson, T.J. Canfield, F.J. Dwyer, C.E. Henke, N.E. Kemble, D.R. Mount, and T.G. Fos, 1996, "Calculation and evaluation of sediment effect concentrations for the amphipod *Hyallela aztca* and the midge *Chironomus riparius*," Journal of Great Lakes Research 22(3): 602-623.

Jones, D.S., G.W. Suter II, and R.N. Hull, 1997, Toxicological Benchmarks for Screening Contaminants of Potential Concern for Effects on Sediment Associated Biota: 1997 Revision, ES/ER/TM-95-R4, Prepared for the Office of Environmental Management, U.S. Department of Energy, Washington, D.C.

MacDonald, D.D., C.G. Ingersoll and T.A. Berger, 2000, "Development and evaluation of consensus-based sediment quality guidelines for freshwater ecosystems," Arch. Environ. Cont. and Tox. 39: 20-31.

MENVIQ/EC, 1992, Interim Criteria for Quality Assessment of St. Lawrence River Sediment, ISBN 0-662-19849-2, St. Lawrence Action Plan, St. Lawrence Center and Ministere de l'Environnement du Quebec, Quebec City, Quebec.

Nagpal, N.K., L.W. Pommen, and L.G. Swain, 1995, Approved and Working Criteria for Water Quality, ISBN 0-7726-2522-0. Water Quality Branch, Ministry of Environment, Lands and Parks, Victoria, British Columbia.

NIPHEP, 1989, Recommended Values for the Classification of Freshwater and Dredged Sediments, Bilthoven, Netherlands.

NYSDEC, 1994, Technical Guidance for Screening Contaminated Sediments, Division of Fish and Wildlife, Division of Marine Resources, Albany, New York.

OMOE, 1987, Guidelines for the Management of Dredged Material in Ontario, Toronto, Ontario.

Stortelder, P.B., M.A. van der Gaag, and L.A. van der Kooij, 1989, Perspectives for Water Organisms, An Ecotoxicological Basis for Quality Objectives for Water and Sediment, Part 1, Results and Calculations, DBW/RIZA Memorandum N. 89.01a, (English Version August 1991), Institute for Inland Water Management and Waste Water Treatment, Lelystad, Netherlands.

TNRCC, 1996, The Surface Water Quality Monitoring Program Supplementary Information Manual, Statewide Percentile Report, Water Planning and Assessment Division, Texas Natural Resource Conservation Commission, Austin, Texas.

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Attachment 3

Evaluation of Additional Data – Woman Creek Aquatic Exposure Unit

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LIST OF TABLES

LIST OF FIGURES

ACRONYMS

AEU	Aquatic Exposure Unit
DOE	U.S. Department of Energy
CRA	Comprehensive Risk Assessment
EU	Exposure Unit
LOAEL	lowest observed effects level
ng/kg	nanogram per kilogram
pg/g	picogram per gram
N/A	not applicable or not available
NOAEL	no observed effects level
NW AEU	North Walnut Creek Aquatic Exposure Unit
SAP	Sampling and Analysis Plan
TEF	toxicity equivalent factor
TEQ	toxicity equivalent
VOC	volatile organic compound
WC AEU	Woman Creek Aquatic Exposure Unit

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Evaluation of Additional Data – Woman Creek Aquatic Exposure Unit

Additional data were collected from the drainage and pond areas to support Comprehensive Risk Assessment (CRA) evaluations in accordance with CRA Sampling and Analysis Plan (SAP) Addendum #05-01, Phase 2 - Targeted Sampling (DOE 2004). For the Woman Creek Aquatic Exposure Unit (EU) (AEU) (WC AEU); one sediment sampling location was identified, and three samples were collected. These samples were differentiated by depth, with surface, immediate subsurface, and subsurface intervals collected. These samples were analyzed for dioxins. Results are shown on Figure 1.

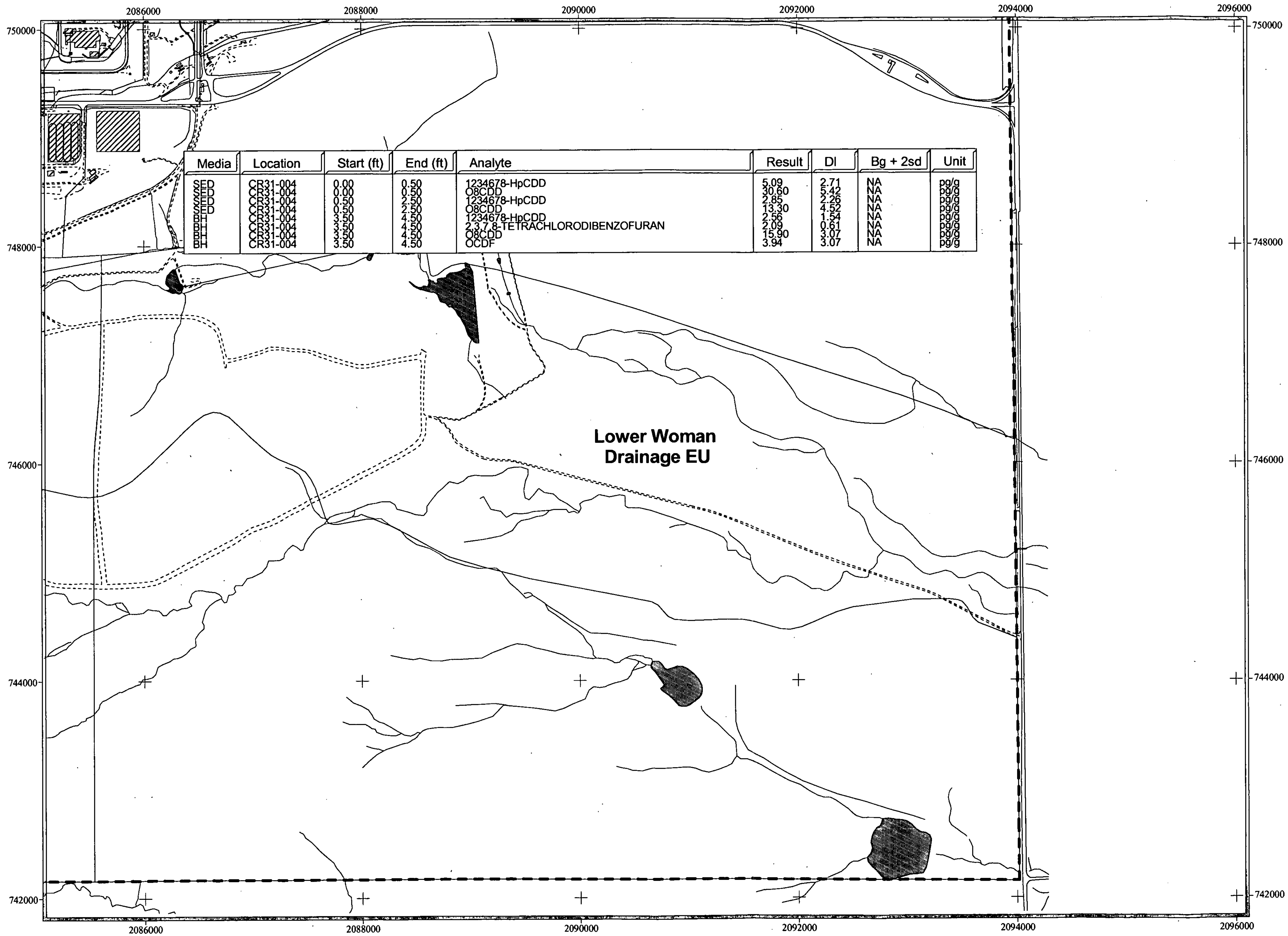
The observed dioxin concentrations were used to develop toxicity equivalent (TEQ) concentrations, using toxicity equivalent factors (TEFs) for each congener. The TEFs for each detected congener are provided in Table 1. The derived TEQ concentrations by sample result are provided in Tables 2 and 3 for surface and subsurface sediment fractions, respectively. The summed totals, by surface and subsurface fraction, are provided in Table 4. The information provided in Table 4 demonstrates two approaches for the total sum. The detected-congeners-only data represent the sum total from detected congeners, while the all-congeners-analyzed data represent a conservative approach where one-half the detection limit is substituted and assumed for nondetected congeners in the calculation.

The results of these analyses were compared to available toxicity benchmarks protective of aquatic life. Values of 0.85 nanogram per kilogram (ng/kg) no observed adverse effect level (NOAEL) and 21.5 ng/kg lowest observed adverse effect level (LOAEL) were used for the comparison (Van den Berg et al. 1998). The summed values provided in Table 4 are less than the LOAEL in all cases (by depth fraction) regardless of approach. The surface sediment concentration using the detected congener total is less than the NOAEL and LOAEL. Values for the conservative approach using the all-congeners-analyzed summed totals exceed the NOAEL but are less than the LOAEL. Because the surface fraction represents the most likely exposure medium to aquatic receptors, risk is low because the observed concentrations are below the NOAEL.

References

DOE, 2004, Final Comprehensive Risk Assessment Sampling and Analysis Plan Addendum #05-01, Phase 2 - Targeted Sampling, Rocky Flats Environmental Technology Site, Golden, Colorado, December.

Van den Berg, M., L. Birnbaum, A.T.C. Bosveld, B. Brunstron, P. Cook, M. Feeley, J.P. Giesy, A. Hanberg, R. Hasegawa, S.W. Kennedy, T. Kubiak, J.C. Larsen, A.K. Djien Liem, C. Nolt, R.E. Peterson, L. Poellinger, S. Safe, D. Schrenk, D. Tillit, M. Tysklind, M. Younes, F. Waern, and T. Zacharewski, 1998, "Toxic equivalency factors (TEFs) for PCBs, PCDDs, PCDFs for humans and wildlife," Environ. Health Pespectives, Vol. 106, No. 12, 775-791.



Media	Location	Start (ft)	End (ft)	Analyte	Result	Dl	Bg + 2sd	Unit
SED	CR31-004	0.00	0.50	1234678-HpCDD	5.09	2.71	NA	pg/g
SED	CR31-004	0.00	0.50	O8CDD	30.60	5.42	NA	pg/g
SED	CR31-004	0.50	2.50	1234678-HpCDD	2.85	2.26	NA	pg/g
SED	CR31-004	0.50	2.50	O8CDD	13.30	4.52	NA	pg/g
BH	CR31-004	3.50	4.50	1234678-HpCDD	2.56	1.54	NA	pg/g
BH	CR31-004	3.50	4.50	2,3,7,8-TETRACHLORODIBENZOFURAN	2.09	0.61	NA	pg/g
BH	CR31-004	3.50	4.50	O8CDD	15.90	3.07	NA	pg/g
BH	CR31-004	3.50	4.50	OCDF	3.94	3.07	NA	pg/g

Figure 3-1
Additional Sampling Results for the Lower Woman Drainage EU

Legend

- Non detect sample location
- Exposure Unit
- Stream
- Pond
- Paved road
- Unpaved road

Structures

- Demolished
- Standing
- Site boundary

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500 0 500 Feet

Scale = 1 : 11,000

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Date: February 21, 2005

RADMS

Prepared for:

KAISER◆HILL COMPANY

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Table 1
Woman Creek TEFs

Dioxin Congener	Aquatic TEF
1,2,3,4,6,7,8-HEPTACHLORODIBENZOFURAN (HpCDF)	0.01
1,2,3,6,7,8-HEXACHLORODIBENZO-P-DIOXIN (HpCDD)	0.01
1,2,3,7,8,9-HEXACHLORODIBENZO-p-DIOXIN (HxCDD)	0.01
1,2,3,7,8-PENTACHLORODIBENZOFURAN (PeCDF)	0.05
1,2,3,7,8-PENTACHLORODIBENZO-p-DIOXIN (PeCDD)	1
1,2,3,4,6,7,8-HpCDD	0.001
1,2,3,4,7,8,9-HpCDF	0.01
1,2,3,4,7,8-HxCDD	0.5
1,2,3,4,7,8-HxCDF	0.1
1,2,3,6,7,8-HxCDF	0.1
1,2,3,7,8,9-HxCDF	0.1
2,3,4,6,7,8-HEXACHLORODIBENZOFURAN (PxCDF)	0.1
2,3,7,8-TETRACHLORODIBENZOFURAN (TCDF)	0.05
2,3,4,7,8-PeCDF	0.5
Dioxin	1
OCDD	0.0001
OCDF	0.0001

Source: Van den Berg et al. 1998

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Table 2
Woman Creek Surface Sediment TEQ Concentrations by Congener

Sample Number	Congener	Start Depth (ft)	End Depth (ft)	Result (pg/g)	Detect	Derived Result [a] (pg/g)	Aquatic TEF (pg/g)	Aquatic TEQ (pg/g)
CR31-004	1,2,3,4,6,7,8-HpCDF	0	0.5	0.807	Yes	0.807	0.01	0.00807
CR31-004	1,2,3,6,7,8-HpCDD	0	0.5	2.71	No	1.355	0.01	0.01355
CR31-004	1,2,3,7,8,9-HxCDD	0	0.5	2.71	No	1.355	0.01	0.01355
CR31-004	1,2,3,7,8-PeCDD	0	0.5	2.71	No	1.355	1	1.355
CR31-004	1,2,3,7,8-PeCDF	0	0.5	2.71	No	1.355	0.05	0.06775
CR31-004	1,2,3,4,6,7,8-HpCDD	0	0.5	5.09	Yes	5.09	0.001	0.00509
CR31-004	1,2,3,4,7,8-HxCDD	0	0.5	2.71	No	1.355	0.5	0.6775
CR31-004	1,2,3,4,7,8-HxCDF	0	0.5	2.71	No	1.355	0.1	0.1355
CR31-004	1,2,3,4,7,8,9-HpCDF	0	0.5	2.71	No	1.355	0.01	0.01355
CR31-004	1,2,3,6,7,8-HxCDF	0	0.5	2.71	No	1.355	0.1	0.1355
CR31-004	1,2,3,7,8,9-HxCDF	0	0.5	2.71	No	1.355	0.1	0.1355
CR31-004	2,3,4,6,7,8-HxCDF	0	0.5	2.71	No	1.355	0.1	0.1355
CR31-004	2,3,7,8-TCDF	0	0.5	1.08	No	0.54	0.05	0.027
CR31-004	2,3,4,7,8-PeCDF	0	0.5	2.71	No	1.355	0.5	0.6775
CR31-004	Dioxin	0	0.5	1.08	No	0.54	1	0.54
CR31-004	O8CDD	0	0.5	30.6	Yes	30.6	0.0001	0.00306
CR31-004	OCDF	0	0.5	1.28	Yes	1.28	0.0001	0.000128

[a] Reported result or one-half the reported result for nondetects.

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Table 3
Woman Creek Subsurface Sediment TEQ Concentrations by Congener

Sample Number	Congener	Start Depth (ft)	End Depth (ft)	Result (pg/g)	Detect	Derived Result [a] (pg/g)	Aquatic TEF (pg/g)	Aquatic TEQ (pg/g)
CR31-004	1,2,3,4,6,7,8-HpCDF	0.5	2.5	1.58	Yes	1.58	0.01	0.0158
CR31-004	1,2,3,6,7,8-HpCDD	0.5	2.5	2.26	No	1.13	0.01	0.0113
CR31-004	1,2,3,7,8,9-HxCDD	0.5	2.5	2.26	No	1.13	0.01	0.0113
CR31-004	1,2,3,7,8-PeCDF	0.5	2.5	2.26	No	1.13	0.05	0.0565
CR31-004	1,2,3,7,8-PeCDD	0.5	2.5	0.372	Yes	0.372	1	0.372
CR31-004	1,2,3,4,6,7,8-HpCDD	0.5	2.5	2.85	Yes	2.85	0.001	0.00285
CR31-004	1,2,3,4,7,8,9-HpCDF	0.5	2.5	2.26	No	1.13	0.01	0.0113
CR31-004	1,2,3,4,7,8-HxCDD	0.5	2.5	2.26	No	1.13	0.5	0.565
CR31-004	1,2,3,4,7,8-HxCDF	0.5	2.5	1.27	Yes	1.27	0.1	0.127
CR31-004	1,2,3,6,7,8-HxCDF	0.5	2.5	0.562	Yes	0.562	0.1	0.0562
CR31-004	1,2,3,7,8,9-HxCDF	0.5	2.5	2.26	No	1.13	0.1	0.113
CR31-004	2,3,4,6,7,8-HxCDF	0.5	2.5	0.781	Yes	0.781	0.1	0.0781
CR31-004	2,3,7,8-TCDF	0.5	2.5	0.904	No	0.452	0.05	0.0226
CR31-004	2,3,4,7,8-PeCDF	0.5	2.5	1.43	Yes	1.43	0.5	0.715
CR31-004	Dioxin	0.5	2.5	0.904	No	0.452	1	0.452
CR31-004	O8CDD	0.5	2.5	13.3	Yes	13.3	0.0001	0.00133
CR31-004	OCDF	0.5	2.5	1.76	Yes	1.76	0.0001	0.000176
CR31-004	1,2,3,4,6,7,8-HpCDF	3.5	4.5	1.54	No	0.77	0.01	0.0077
CR31-004	1,2,3,6,7,8-HpCDD	3.5	4.5	1.54	No	0.77	0.01	0.0077
CR31-004	1,2,3,7,8,9-HxCDD	3.5	4.5	1.54	No	0.77	0.01	0.0077
CR31-004	1,2,3,7,8-PeCDF	3.5	4.5	0.427	Yes	0.427	0.05	0.02135
CR31-004	1,2,3,7,8-PeCDD	3.5	4.5	1.54	No	0.77	1	0.77
CR31-004	1,2,3,4,6,7,8-HpCDD	3.5	4.5	2.56	Yes	2.56	0.001	0.00256
CR31-004	1,2,3,4,7,8,9-HpCDF	3.5	4.5	1.54	No	0.77	0.01	0.0077
CR31-004	1,2,3,4,7,8-HxCDD	3.5	4.5	1.54	No	0.77	0.5	0.385
CR31-004	1,2,3,4,7,8-HxCDF	3.5	4.5	1.54	No	0.77	0.1	0.077
CR31-004	1,2,3,6,7,8-HxCDF	3.5	4.5	1.54	No	0.77	0.1	0.077
CR31-004	1,2,3,7,8,9-HxCDF	3.5	4.5	1.54	No	0.77	0.1	0.077
CR31-004	2,3,4,6,7,8-HxCDF	3.5	4.5	1.54	No	0.77	0.1	0.077
CR31-004	2,3,7,8-TCDF	3.5	4.5	2.09	Yes	2.09	0.05	0.1045
CR31-004	2,3,4,7,8-PeCDF	3.5	4.5	0.77	Yes	0.77	0.5	0.385
CR31-004	Dioxin	3.5	4.5	0.533	Yes	0.533	1	0.533
CR31-004	O8CDD	3.5	4.5	15.9	Yes	15.9	0.0001	0.00159
CR31-004	OCDF	3.5	4.5	3.94	Yes	3.94	0.0001	0.000394
CR31-004	1,2,3,4,6,7,8-HpCDF	4.5	6.5	0.832	Yes	0.832	0.01	0.00832
CR31-004	1,2,3,6,7,8-HpCDD	4.5	6.5	1.47	No	0.735	0.01	0.00735
CR31-004	1,2,3,7,8,9-HxCDD	4.5	6.5	1.47	No	0.735	0.01	0.00735
CR31-004	1,2,3,7,8-PeCDF	4.5	6.5	1.47	No	0.735	0.05	0.03675
CR31-004	1,2,3,7,8-PeCDD	4.5	6.5	1.47	No	0.735	1	0.735
CR31-004	1,2,3,4,6,7,8-HpCDD	4.5	6.5	1.53	No	0.765	0.001	0.000765
CR31-004	1,2,3,4,7,8,9-HpCDF	4.5	6.5	1.47	No	0.735	0.01	0.00735
CR31-004	1,2,3,4,7,8-HxCDD	4.5	6.5	1.47	No	0.735	0.5	0.3675
CR31-004	1,2,3,4,7,8-HxCDF	4.5	6.5	1.47	No	0.735	0.1	0.0735

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Sample Number	Congener	Start Depth (ft)	End Depth (ft)	Result (pg/g)	Detect	Derived Result[a] (pg/g)	Aquatic TEF (pg/g)	Aquatic TEQ (pg/g)
CR31-004	1,2,3,6,7,8-HxCDF	4.5	6.5	1.47	No	0.735	0.1	0.0735
CR31-004	1,2,3,7,8,9-HxCDF	4.5	6.5	1.47	No	0.735	0.1	0.0735
CR31-004	2,3,4,6,7,8-PeCDD	4.5	6.5	0.339	Yes	0.339	0.1	0.0339
CR31-004	2,3,7,8-TCDF	4.5	6.5	0.587	No	0.2935	0.05	0.014675
CR31-004	2,3,4,7,8-PeCDF	4.5	6.5	1.47	No	0.735	0.5	0.3675
CR31-004	Dioxin	4.5	6.5	0.587	No	0.2935	1	0.2935
CR31-004	O8CDD	4.5	6.5	2	Yes	2	0.0001	0.0002
CR31-004	OCDF	4.5	6.5	2.93	No	1.465	0.0001	0.0001465

[a] Reported result or one-half the reported result for nondetects.

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Table 4
Woman Creek Summed Total TEQ Concentrations by Depth Fraction

Sample Number	Start Depth (ft)	End Depth (ft)	Detected Congeners Only	All Congeners Analyzed [a]
Subsurface Sediments (pg/g)				
CR31-004	0.5	2.5	1.37	2.61
CR31-004	3.5	4.5	1.05	2.54
CR31-004	4.5	6.5	0.04	2.10
Surface Sediments (pg/g)				
CR31-004	0	0.5	0.02	3.94

[a] Reported results or one half of the reported result for nondetects used in the TEQ calculation.

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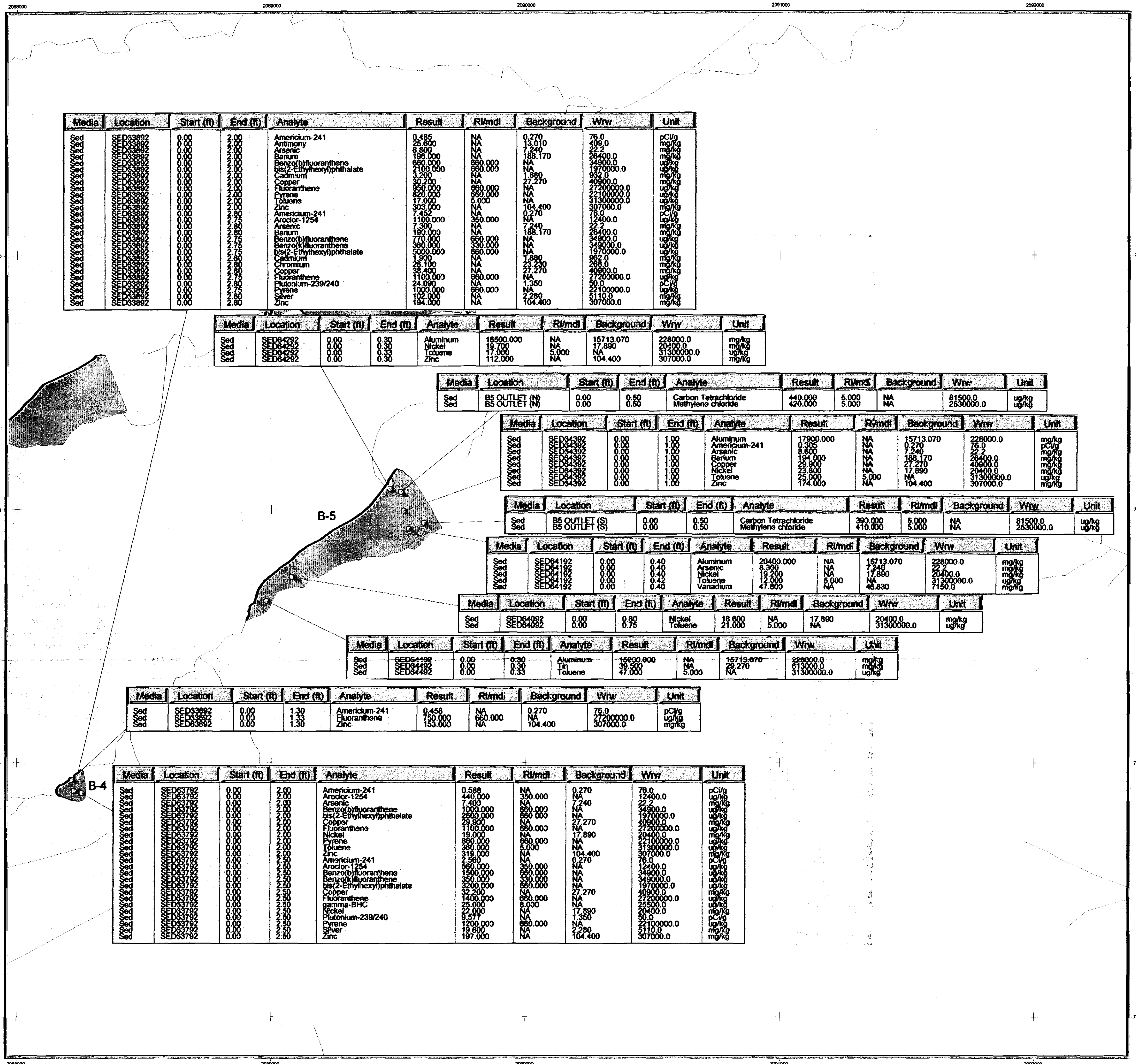

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED63892	0.00	2.00	Americium-241	0.485	NA	0.270	76.0	pCi/g
Sed	SED63892	0.00	2.00	Antimony	25.600	NA	13.010	409.0	mg/kg
Sed	SED63892	0.00	2.00	Arsenic	8.800	NA	7.240	22.2	mg/kg
Sed	SED63892	0.00	2.00	Barium	196.000	NA	188.170	26400.0	mg/kg
Sed	SED63892	0.00	2.00	Benzo(b)fluoranthene	660.000	660.000	NA	34900.0	ug/kg
Sed	SED63892	0.00	2.00	bis(2-Ethylhexyl)phthalate	2100.000	660.000	NA	1970000.0	ug/kg
Sed	SED63892	0.00	2.00	Cadmium	3.200	NA	1.880	962.0	mg/kg
Sed	SED63892	0.00	2.00	Copper	30.200	NA	27.270	40900.0	mg/kg
Sed	SED63892	0.00	2.00	Fluoranthene	950.000	660.000	NA	27200000.0	ug/kg
Sed	SED63892	0.00	2.00	Pyrene	820.000	660.000	NA	22100000.0	ug/kg
Sed	SED63892	0.00	2.00	Toluene	17.000	5.000	NA	31300000.0	ug/kg
Sed	SED63892	0.00	2.00	Zinc	303.000	NA	104.400	307000.0	mg/kg
Sed	SED63892	0.00	2.80	Americium-241	7.452	NA	0.270	76.0	pCi/g
Sed	SED63892	0.00	2.75	Aroclor-1254	1100.000	350.000	NA	12400.0	ug/kg
Sed	SED63892	0.00	2.80	Arsenic	7.300	NA	7.240	22.2	mg/kg
Sed	SED63892	0.00	2.80	Barium	190.000	NA	188.170	26400.0	mg/kg
Sed	SED63892	0.00	2.75	Benzo(b)fluoranthene	770.000	660.000	NA	34900.0	ug/kg
Sed	SED63892	0.00	2.75	Benzo(k)fluoranthene	360.000	330.000	NA	349000.0	ug/kg
Sed	SED63892	0.00	2.75	bis(2-Ethylhexyl)phthalate	5000.000	660.000	NA	1970000.0	ug/kg
Sed	SED63892	0.00	2.80	Cadmium	1.900	NA	1.880	962.0	mg/kg
Sed	SED63892	0.00	2.80	Chromium	26.100	NA	23.230	268.0	mg/kg
Sed	SED63892	0.00	2.80	Copper	38.400	NA	27.270	40900.0	mg/kg
Sed	SED63892	0.00	2.75	Fluoranthene	1100.000	660.000	NA	27200000.0	ug/kg
Sed	SED63892	0.00	2.80	Plutonium-239/240	24.090	NA	1.350	50.0	pCi/g
Sed	SED63892	0.00	2.75	Pyrene	1000.000	660.000	NA	22100000.0	ug/kg
Sed	SED63892	0.00	2.80	Silver	102.000	NA	2.280	5110.0	mg/kg
Sed	SED63892	0.00	2.80	Zinc	194.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64292	0.00	0.30	Aluminum	16500.000	NA	15713.070	228000.0	mg/kg
Sed	SED64292	0.00	0.30	Nickel	19.700	NA	17.890	20400.0	mg/kg
Sed	SED64292	0.00	0.33	Toluene	17.000	5.000	NA	31300000.0	ug/kg
Sed	SED64292	0.00	0.30	Zinc	112.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	B5 OUTLET (N)	0.00	0.50	Carbon Tetrachloride	440.000	5.000	NA	81500.0	ug/kg
Sed	B5 OUTLET (N)	0.00	0.50	Methylene chloride	420.000	5.000	NA	2530000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64392	0.00	1.00	Aluminum	17900.000	NA	15713.070	226000.0	mg/kg
Sed	SED64392	0.00	1.00	Americium-241	0.305	NA	0.270	76.0	pCi/g
Sed	SED64392	0.00	1.00	Arsenic	8.600	NA	7.240	22.2	mg/kg
Sed	SED64392	0.00	1.00	Barium	194.000	NA	188.170	26400.0	mg/kg
Sed	SED64392	0.00	1.00	Copper	29.900	NA	27.270	40900.0	mg/kg
Sed	SED64392	0.00	1.00	Nickel	23.800	NA	17.890	20400.0	mg/kg
Sed	SED64392	0.00	1.00	Toluene	25.000	5.000	NA	31300000.0	ug/kg
Sed	SED64392	0.00	1.00	Zinc	174.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	B5 OUTLET (S)	0.00	0.50	Carbon Tetrachloride	390.000	5.000	NA	81500.0	ug/kg
Sed	B5 OUTLET (S)	0.00	0.50	Methylene chloride	410.000	5.000	NA	2530000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64192	0.00	0.40	Aluminum	20400.000	NA	15713.070	228000.0	mg/kg
Sed	SED64192	0.00	0.40	Arsenic	8.300	NA	7.240	22.2	mg/kg
Sed	SED64192	0.00	0.40	Nickel	19.200	NA	17.890	20400.0	mg/kg
Sed	SED64192	0.00	0.42	Toluene	12.000	5.000	NA	31300000.0	ug/kg
Sed	SED64192	0.00	0.40	Vanadium	47.800	NA	46.830	7150.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64092	0.00	0.80	Nickel	18.600	NA	17.890	20400.0	mg/kg
Sed	SED64092	0.00	0.75	Toluene	21.000	5.000	NA	31300000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED64492	0.00	0.30	Aluminum	15930.000	NA	15713.070	228000.0	mg/kg
Sed	SED64492	0.00	0.30	Tin	39.500	NA	29.270	613000.0	mg/kg
Sed	SED64492	0.00	0.33	Toluene	47.000	5.000	NA	31300000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED63692	0.00	1.30	Americium-241	0.458	NA	0.270	76.0	pCi/g
Sed	SED63692	0.00	1.33	Fluoranthene	750.000	660.000	NA	27200000.0	ug/kg
Sed	SED63692	0.00	1.30	Zinc	153.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED63792	0.00	2.00	Americium-241	0.588	NA	0.270	76.0	pCi/g
Sed	SED63792	0.00	2.00	Aroclor-1254	440.000	350.000	NA	12400.0	ug/kg
Sed	SED63792	0.00	2.00	Arsenic	7.400	NA	7.240	22.2	mg/kg
Sed	SED63792	0.00	2.00	Benzo(b)fluoranthene	1000.000	660.000	NA	34900.0	ug/kg
Sed	SED63792	0.00	2.00	bis(2-Ethylhexyl)phthalate	2600.000	660.000	NA	1970000.0	ug/kg
Sed	SED63792	0.00	2.00	Copper	29.900	NA	27.270	40900.0	mg/kg
Sed	SED63792	0.00	2.00	Fluoranthene	1100.000	660.000	NA	27200000.0	ug/kg
Sed	SED63792	0.00	2.00	Nickel	19.000	NA	17.890	20400.0	mg/kg
Sed	SED63792	0.00	2.00	Pyrene	860.000	660.000	NA	22100000.0	ug/kg
Sed	SED63792	0.00	2.00	Toluene	360.000	5.000	NA	31300000.0	ug/kg
Sed	SED63792	0.00	2.00	Zinc	319.000	NA	104.400	307000.0	mg/kg
Sed	SED63792	0.00	2.50	Americium-241	2.560	NA	0.270	76.0	pCi/g
Sed	SED63792	0.00	2.50	Aroclor-1254	560.000	350.000	NA	12400.0	ug/kg
Sed	SED63792	0.00	2.50	Benzo(b)fluoranthene	1500.000	660.000	NA	34900.0	ug/kg
Sed	SED63792	0.00	2.50	Benzo(k)fluoranthene	350.000	330.000	NA	349000.0	ug/kg
Sed	SED63792	0.00	2.50	bis(2-Ethylhexyl)phthalate	3200.000	660.000	NA	1970000.0	ug/kg
Sed	SED63792	0.00	2.50	Copper	32.200	NA	27.270	40900.0	mg/kg
Sed	SED63792	0.00	2.50	Fluoranthene	1400.000	660.000	NA	27200000.0	ug/kg
Sed	SED63792	0.00	2.50	gamma-BHC	25.000	8.000	NA	25500.0	ug/kg
Sed	SED63792	0.00	2.50	Nickel	22.000	NA	17.890	20400.0	mg/kg
Sed	SED63792	0.00	2.50	Plutonium-239/240	9.577	NA	1.350	50.0	pCi/g
Sed	SED63792	0.00	2.50	Pyrene	1200.000	660.000	NA	22100000.0	ug/kg
Sed	SED63792	0.00	2.50	Silver	19.600	NA	2.280	5110.0	mg/kg
Sed	SED63792	0.00	2.50	Zinc	197.000	NA	104.400	307000.0	mg/kg

Figure 4
Ponds B-4 and B-5 Sediment Results Greater Than Background Means Plus Two Standard Deviations or RLs/MDLs

KEY

- Result greater than background/RL/MDL and less than WRW AL
- Stream
- Pond

DRAFT

N
W E
S

300 0 300 Feet

Scale 1: 3500

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: Date: 3.24.05

RADMS

Prepared for:

KAISER+HILL COMPANY

File: W:\Projects\FY2005\CRA\Ponds\ponds.apr

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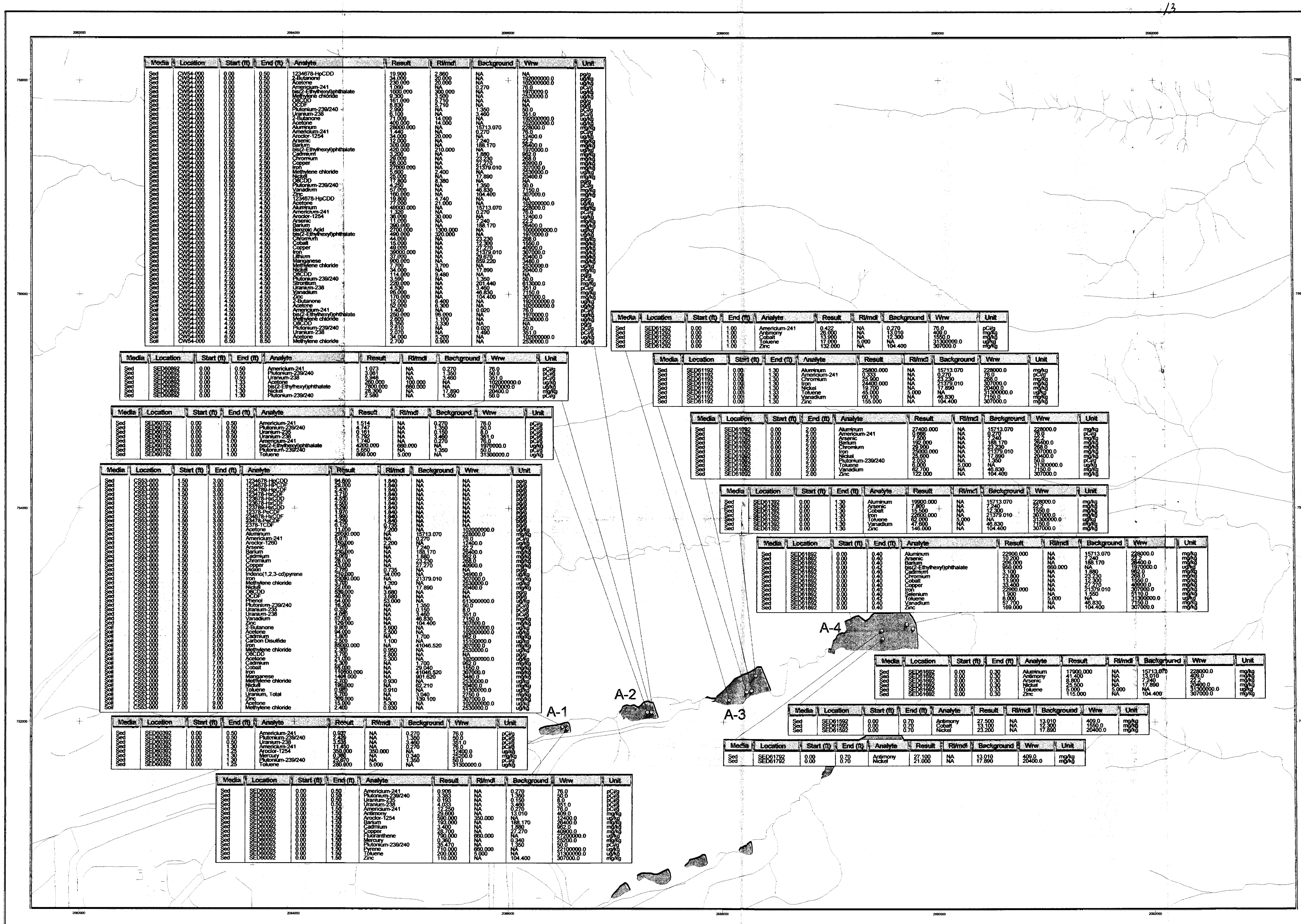

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	CW54-000	0.00	0.50	1234678-HpCDD	19.900	2.860	NA	NA	pg/g
Sed	CW54-000	0.00	0.50	2-Butanone	34.000	20.000	NA	192000000.0	ug/kg
Sed	CW54-000	0.00	0.50	Acetone	230.000	20.000	NA	102000000.0	ug/kg
Sed	CW54-000	0.00	0.50	Americium-241	1.060	NA	0.270	76.0	pCi/g
Sed	CW54-000	0.00	0.50	bis(2-Ethylhexyl)phthalate	1000.000	300.000	NA	1970000.0	ug/kg
Sed	CW54-000	0.00	0.50	Methylene chloride	9.300	3.500	NA	2530000.0	ug/kg
Sed	CW54-000	0.00	0.50	O8CDD	161.000	5.710	NA	NA	pg/g
Sed	CW54-000	0.00	0.50	OCDF	8.830	5.710	NA	NA	pg/g
Sed	CW54-000	0.00	0.50	Plutonium-239/240	2.990	NA	1.350	50.0	pCi/g
Sed	CW54-000	0.00	0.50	Uranium-238	6.100	NA	3.460	351.0	pCi/g
Sed	CW54-000	0.50	2.50	2-Butanone	71.000	14.000	NA	192000000.0	ug/kg
Sed	CW54-000	0.50	2.50	Acetone	400.000	14.000	NA	102000000.0	ug/kg
Sed	CW54-000	0.50	2.50	Aluminum	28000.000	NA	15713.070	228000.0	mg/kg
Sed	CW54-000	0.50	2.50	Americium-241	1.440	NA	0.270	76.0	pCi/g
Sed	CW54-000	0.50	2.50	Aroclor-1254	34.000	20.000	NA	12400.0	ug/kg
Sed	CW54-000	0.50	2.50	Arsenic	12.000	NA	7.240	22.2	mg/kg
Sed	CW54-000	0.50	2.50	Barium	300.000	NA	188.170	26400.0	mg/kg
Sed	CW54-000	0.50	2.50	bis(2-Ethylhexyl)phthalate	420.000	210.000	NA	1970000.0	ug/kg
Sed	CW54-000	0.50	2.50	Cadmium	3.200	NA	1.880	962.0	mg/kg
Sed	CW54-000	0.50	2.50	Chromium	29.000	NA	23.230	268.0	mg/kg
Sed	CW54-000	0.50	2.50	Copper	56.000	NA	27.270	40900.0	mg/kg
Sed	CW54-000	0.50	2.50	Iron	27000.000	NA	21379.010	307000.0	mg/kg
Sed	CW54-000	0.50	2.50	Methylene chloride	5.600	2.400	NA	2530000.0	ug/kg
Sed	CW54-000	0.50	2.50	Nickel	25.000	NA	17.890	20400.0	mg/kg
Sed	CW54-000	0.50	2.50	O8CDD	17.800	8.380	NA	NA	pg/g
Sed	CW54-000	0.50	2.50	Plutonium-239/240	4.250	NA	1.350	50.0	pCi/g
Sed	CW54-000	0.50	2.50	Vanadium	57.000	NA	46.830	7150.0	mg/kg
Sed	CW54-000	0.50	2.50	Zinc	160.000	NA	104.400	307000.0	mg/kg
Sed	CW54-000	2.50	4.50	1234678-HpCDD	19.800	4.740	NA	NA	pg/g
Sed	CW54-000	2.50	4.50	Acetone	77.000	21.000	NA	102000000.0	ug/kg
Sed	CW54-000	2.50	4.50	Aluminum	49000.000	NA	15713.070	228000.0	mg/kg
Sed	CW54-000	2.50	4.50	Americium-241	1.320	NA	0.270	76.0	pCi/g
Sed	CW54-000	2.50	4.50	Aroclor-1254	36.000	30.000	NA	12400.0	ug/kg
Sed	CW54-000	2.50	4.50	Arsenic	11.000	NA	7.240	22.2	mg/kg
Sed	CW54-000	2.50	4.50	Barium	390.000	NA	188.170	26400.0	mg/kg
Sed	CW54-000	2.50	4.50	Benzoic Acid	2700.000	1300.000	NA	1000000000.0	ug/kg
Sed	CW54-000	2.50	4.50	bis(2-Ethylhexyl)phthalate	490.000	320.000	NA	1970000.0	ug/kg
Sed	CW54-000	2.50	4.50	Chromium	44.000	NA	23.230	268.0	mg/kg
Sed	CW54-000	2.50	4.50	Cobalt	15.000	NA	12.300	1550.0	mg/kg
Sed	CW54-000	2.50	4.50	Copper	49.000	NA	27.270	40900.0	mg/kg
Sed	CW54-000	2.50	4.50	Iron	39000.000	NA	21379.010	307000.0	mg/kg
Sed	CW54-000	2.50	4.50	Lithium	37.000	NA	29.670	20400.0	mg/kg
Sed	CW54-000	2.50	4.50	Manganese	900.000	NA	659.220	3480.0	mg/kg
Sed	CW54-000	2.50	4.50	Methylene chloride	7.700	3.700	NA	2530000.0	ug/kg
Sed	CW54-000	2.50	4.50	Nickel	34.000	NA	17.890	20400.0	mg/kg
Sed	CW54-000	2.50	4.50	O8CDD	114.000	9.480	NA	NA	pg/g
Sed	CW54-000	2.50	4.50	Plutonium-239/240	3.590	NA	1.350	50.0	pCi/g
Sed	CW54-000	2.50	4.50	Strontium	220.000	NA	201.440	613000.0	mg/kg
Sed	CW54-000	2.50	4.50	Uranium-238	4.530	NA	3.460	351.0	pCi/g
Sed	CW54-000	2.50	4.50	Vanadium	86.000	NA	46.830	7150.0	mg/kg
Sed	CW54-000	2.50	4.50	Zinc	170.000	NA	104.400	307000.0	mg/kg
Soil	CW54-000	4.50	6.50	2-Butanone	12.000	6.400	NA	192000000.0	ug/kg
Soil	CW54-000	4.50	6.50	Acetone	52.000	6.300	NA	102000000.0	ug/kg
Soil	CW54-000	4.50	6.50	Americium-241	1.400	NA	0.020	76.0	pCi/g
Soil	CW54-000	4.50	6.50	bis(2-Ethylhexyl)phthalate	250.000	96.000	NA	1970000.0	ug/kg
Soil	CW54-000	4.50	6.50	Methylene chloride	2.600	1.100	NA	2530000.0	ug/kg
Soil	CW54-000	4.50	6.50	O8CDD	8.350	3.330	NA	NA	pg/g
Soil	CW54-000	4.50	6.50	Plutonium-239/240	2.610	NA	0.020	50.0	pCi/g
Soil	CW54-000	4.50	6.50	Uranium-238	2.070	NA	1.490	351.0	pCi/g
Soil	CW54-000	6.50	8.50	Acetone	34.000	5.200	NA	102000000.0	ug/kg
Soil	CW54-000	6.50	8.50	Methylene chloride	2.700	0.900	NA	2530000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED61292	0.00	1.00	Americium-241	0.422	NA	0.270	76.0	pCi/g
Sed	SED61292	0.00	1.00	Antimony	26.000	NA	13.010	409.0	mg/kg
Sed	SED61292	0.00	1.00	Cobalt	13.900	NA	12.300	1550.0	mg/kg
Sed	SED61292	0.00	1.00	Toluene	17.000	5.000	NA	31300000.0	ug/kg
Sed	SED61292	0.00	1.00	Zinc	132.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED60892	0.00	0.50	Americium-241	1.073	NA	0.270	76.0	pCi/g
Sed	SED60892	0.00	0.50	Plutonium-239/240	3.081	NA	1.350	50.0	pCi/g
Sed	SED60892	0.00	0.50	Uranium-238	5.948	NA	3.460	351.0	pCi/g
Sed	SED60892	0.00	1.33	Acetone	260.000	100.000	NA	102000000.0	ug/kg
Sed	SED60892	0.00	1.33	bis(2-Ethylhexyl)phthalate	7800.000	660.000	NA	1970000.0	ug/kg
Sed	SED60892	0.00	1.30	Nickel	28.300	NA	17.890	20400.0	mg/kg
Sed	SED60892	0.00	1.30	Plutonium-239/240	2.580	NA	1.350	50.0	pCi/g

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED61192	0.00	1.30	Aluminum	25800.000	NA	15713.070	228000.0	mg/kg
Sed	SED61192	0.00	1.30	Americium-241	0.333	NA	0.270	76.0	pCi/g
Sed	SED61192	0.00	1.30	Chromium	25.900	NA	23.230	268.0	mg/kg
Sed	SED61192	0.00	1.30	Iron	24400.000	NA	21379.010	307000.0	mg/kg
Sed	SED61192	0.00	1.30	Nickel	19.700	NA	17.890	20400.0	mg/kg
Sed	SED61192	0.00	1.33	Toluene	45.000	5.000	NA	31300000.0	ug/kg
Sed	SED61192	0.00	1.30	Vanadium	60.100	NA	46.830	7150.0	mg/kg
Sed	SED61192	0.00	1.30	Zinc	155.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED60792	0.00	0.50	Americium-241	1.514	NA	0.270	76.0	pCi/g
Sed	SED60792	0.00	0.50	Plutonium-239/240	4.141	NA	1.350	50.0	pCi/g
Sed	SED60792	0.00	0.50	Uranium-235	[illegible]	NA	[illegible]	[illegible]	pCi/g
Sed	SED60792	0.00	0.50	Uranium-238	5.792	NA	3.460	351.0	pCi/g
Sed	SED60792	0.00	1.00	Americium-241	1.740	NA	0.270	76.0	pCi/g
Sed	SED60792	0.00	1.00	bis(2-Ethylhexyl)phthalate	4200.000	660.000	NA	1970000.0	ug/kg
Sed	SED60792	0.00	1.00	Plutonium-239/240	5.650	NA	1.350	50.0	pCi/g
Sed	SED60792	0.00	1.00	Toluene	860.000	5.000	NA	31300000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED61092	0.00	2.00	Aluminum	27400.000	NA	15713.070	228000.0	mg/kg
Sed	SED61092	0.00	2.00	Americium-241	0.666	NA	0.270	76.0	pCi/g
Sed	SED61092	0.00	2.00	Arsenic	7.500	NA	7.240	22.2	mg/kg
Sed	SED61092	0.00	2.00	Barium	192.000	NA	188.170	26400.0	mg/kg
Sed	SED61092	0.00	2.00	Chromium	29.900	NA	23.230	268.0	mg/kg
Sed	SED61092	0.00	2.00	Iron	25000.000	NA	21379.010	307000.0	mg/kg
Sed	SED61092	0.00	2.00	Nickel	25.600	NA	17.890	20400.0	mg/kg
Sed	SED61092	0.00	2.00	Plutonium-239/240	2.053	NA	1.350	50.0	pCi/g
Sed	SED61092	0.00	2.00	Toluene	6.000	5.000	NA	31300000.0	ug/kg
Sed	SED61092	0.00	2.00	Vanadium	62.700	NA	46.830	7150.0	mg/kg
Sed	SED61092	0.00	2.00	Zinc	122.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	CS53-000	1.50	3.00	1234678-HpCDD	94.800	1.840	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	1234678-HpCDF	[illegible]	1.840	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	1234789-HpCDF	[illegible]	1.840	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	123478-HxCDF	[illegible]	1.840	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	[illegible]	[illegible]	1.840	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	[illegible]	[illegible]	1.840	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	12378-PeCDF	[illegible]	1.840	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	[illegible]	[illegible]	1.840	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	23478-PeCDF	[illegible]	1.840	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	2378-TCDF	[illegible]	[illegible]	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	Acetone	11.000	7.200	NA	102000000.0	ug/kg
Sed	CS53-000	1.50	3.00	Aluminum	20800.000	NA	15713.070	228000.0	mg/kg
Sed	CS53-000	1.50	3.00	Americium-241	[illegible]	NA	0.270	76.0	pCi/g
Sed	CS53-000	1.50	3.00	Aroclor-1260	[illegible]	[illegible]	NA	12400.0	ug/kg
Sed	CS53-000	1.50	3.00	Arsenic	[illegible]	NA	7.240	22.2	mg/kg
Sed	CS53-000	1.50	3.00	Barium	[illegible]	NA	188.170	26400.0	mg/kg
Sed	CS53-000	1.50	3.00	Cadmium	[illegible]	NA	1.880	962.0	mg/kg
Sed	CS53-000	1.50	3.00	Chromium	[illegible]	NA	23.230	268.0	mg/kg
Sed	CS53-000	1.50	3.00	Copper	[illegible]	NA	27.270	40900.0	mg/kg
Sed	CS53-000	1.50	3.00	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]	[illegible]
Sed	CS53-000	1.50	3.00	Indeno(1,2,3-cd)pyrene	[illegible]	[illegible]	NA	[illegible]	ug/kg
Sed	CS53-000	1.50	3.00	Iron	[illegible]	NA	21379.010	307000.0	mg/kg
Sed	CS53-000	1.50	3.00	Methylene chloride	[illegible]	[illegible]	NA	2530000.0	ug/kg
Sed	CS53-000	1.50	3.00	Nickel	[illegible]	NA	17.890	20400.0	mg/kg
Sed	CS53-000	1.50	3.00	O8CDD	[illegible]	[illegible]	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	OCDF	[illegible]	[illegible]	NA	NA	pg/g
Sed	CS53-000	1.50	3.00	Phenol	[illegible]	[illegible]	NA	[illegible]	ug/kg
Sed	CS53-000	1.50	3.00	Plutonium-239/240	[illegible]	NA	1.350	50.0	pCi/g
Sed	CS53-000	1.50	3.00	Uranium-235	[illegible]	NA	0.150	8.0	pCi/g
Sed	CS53-000	1.50	3.00	Uranium-238	[illegible]	NA	3.460	351.0	pCi/g
Sed	CS53-000	1.50	3.00	Vanadium	57.000	NA	46.830	7150.0	mg/kg
Sed	CS53-000	1.50	3.00	Zinc	[illegible]	NA	104.400	307000.0	mg/kg
Soil	CS53-000	3.00	5.00	2-Butanone	[illegible]	[illegible]	NA	192000000.0	ug/kg
Soil	CS53-000	3.00	5.00	Acetone	[illegible]	[illegible]	NA	102000000.0	ug/kg
Soil	CS53-000	3.00	5.00	Cadmium	[illegible]	NA	1.700	962.0	mg/kg
Soil	CS53-000	3.00	5.00	Carbon Disulfide	[illegible]	[illegible]	NA	[illegible]	ug/kg
Soil	CS53-000	3.00	5.00	Iron	[illegible]	NA	41046.520	307000.0	mg/kg
Soil	CS53-000	3.00	5.00	Methylene chloride	[illegible]	[illegible]	NA	2530000.0	ug/kg
Soil	CS53-000	3.00	5.00	O8CDD	[illegible]	[illegible]	NA	NA	pg/g
Soil	CS53-000	5.00	7.00	Acetone	21.000	5.300	NA	102000000.0	ug/kg
Soil	CS53-000	5.00	7.00	Cadmium	2.300	NA	1.700	962.0	mg/kg
Soil	CS53-000	5.00	7.00	Cobalt	55.000	NA	29.040	1550.0	mg/kg
Soil	CS53-000	5.00	7.00	Iron	110000.000	NA	41046.520	307000.0	mg/kg
Soil	CS53-000	5.00	7.00	Manganese	1404.000	NA	901.620	3480.0	mg/kg
Soil	CS53-000	5.00	7.00	Methylene chloride	2.700	0.930	NA	2530000.0	ug/kg
Soil	CS53-000	5.00	7.00	Nickel	190.000	NA	62.210	20400.0	mg/kg
Soil	CS53-000	5.00	7.00	Toluene	0.980	0.910	NA	31300000.0	ug/kg
Soil	CS53-000	5.00	7.00	Uranium, Total	5.700	NA	3.040	2750.0	mg/kg
Soil	CS53-000	5.00	7.00	Zinc	300.000	NA	139.100	307000.0	mg/kg
Soil	CS53-000	7.00	9.00	Acetone	15.000	5.300	NA	102000000.0	ug/kg
Soil	CS53-000	7.00	9.00	Methylene chloride	2.400	0.930	NA	2530000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED61392	0.00	1.30	Aluminum	19900.000	NA	15713.070	228000.0	mg/kg
Sed	SED61392	0.00	1.30	Arsenic	7.800	NA	7.240	22.2	mg/kg
Sed	SED61392	0.00	1.30	Cobalt	15.500	NA	12.300	1550.0	mg/kg
Sed	SED61392	0.00	1.30	Iron	22600.000	NA	21379.010	307000.0	mg/kg
Sed	SED61392	0.00	1.33	Toluene	62.000	5.000	NA	31300000.0	ug/kg
Sed	SED61392	0.00	1.30	Vanadium	47.600	NA	46.830	7150.0	mg/kg
Sed	SED61392	0.00	1.30	Zinc	146.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED61892	0.00	0.40	Aluminum	22900.000	NA	15713.070	228000.0	mg/kg
Sed	SED61892	0.00	0.40	Arsenic	10.200	NA	7.240	22.2	mg/kg
Sed	SED61892	0.00	0.40	Barium	206.000	NA	188.170	26400.0	mg/kg
Sed	SED61892	0.00	0.42	bis(2-Ethylhexyl)phthalate	950.000	660.000	NA	1970000.0	ug/kg
Sed	SED61892	0.00	0.40	Cadmium	3.100	NA	1.880	962.0	mg/kg
Sed	SED61892	0.00	0.40	Chromium	23.800	NA	23.230	268.0	mg/kg
Sed	SED61892	0.00	0.40	Cobalt	13.900	NA	12.300	1550.0	mg/kg
Sed	SED61892	0.00	0.40	Copper	33.400	NA	27.270	40900.0	mg/kg
Sed	SED61892	0.00	0.40	Iron	22900.000	NA	21379.010	307000.0	mg/kg
Sed	SED61892	0.00	0.40	Selenium	1.900	NA	1.550	5110.0	mg/kg
Sed	SED61892	0.00	0.42	Toluene	8.000	5.000	NA	31300000.0	ug/kg
Sed	SED61892	0.00	0.40	Vanadium	57.700	NA	46.830	7150.0	mg/kg
Sed	SED61892	0.00	0.40	Zinc	169.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED61692	0.00	0.30	Aluminum	17900.000	NA	15713.070	228000.0	mg/kg
Sed	SED61692	0.00	0.30	Antimony	41.400	NA	13.010	409.0	mg/kg
Sed	SED61692	0.00	0.30	Arsenic	8.800	NA	7.240	22.2	mg/kg
Sed	SED61692	0.00	0.30	Nickel	25.500	NA	17.890	20400.0	mg/kg
Sed	SED61692	0.00	0.33	Toluene	5.000	5.000	NA	31300000.0	ug/kg
Sed	SED61692	0.00	0.30	Zinc	115.000	NA	104.400	307000.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED61592	0.00	0.70	Antimony	27.500	NA	13.010	409.0	mg/kg
Sed	SED61592	0.00	0.70	Cobalt	13.100	NA	12.300	1550.0	mg/kg
Sed	SED61592	0.00	0.70	Nickel	23.200	NA	17.890	20400.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED60392	0.00	0.50	Americium-241	0.937	NA	0.270	76.0	pCi/g
Sed	SED60392	0.00	0.50	Plutonium-239/240	2.429	NA	1.350	50.0	pCi/g
Sed	SED60392	0.00	0.50	Uranium-238	3.535	NA	3.460	351.0	pCi/g
Sed	SED60392	0.00	1.30	Americium-241	11.400	NA	0.270	76.0	pCi/g
Sed	SED60392	0.00	1.25	Aroclor-1254	350.000	350.000	NA	12400.0	ug/kg
Sed	SED60392	0.00	1.30	Mercury	0.380	NA	0.340	25200.0	mg/kg
Sed	SED60392	0.00	1.30	Plutonium-239/240	25.670	NA	1.350	50.0	pCi/g
Sed	SED60392	0.00	1.25	Toluene	280.000	5.000	NA	31300000.0	ug/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED61792	0.00	0.70	Antimony	27.100	NA	13.010	409.0	mg/kg
Sed	SED61792	0.00	0.70	Nickel	21.000	NA	17.890	20400.0	mg/kg

Media	Location	Start (ft)	End (ft)	Analyte	Result	Rl/mdl	Background	Wrw	Unit
Sed	SED60092	0.00	0.50	Americium-241	0.906	NA	0.270	76.0	pCi/g
Sed	SED60092	0.00	0.50	Plutonium-239/240	3.383	NA	1.350	50.0	pCi/g
Sed	SED60092	0.00	0.50	Uranium-235	0.193	NA	0.150	8.0	pCi/g
Sed	SED60092	0.00	0.50	Uranium-238	4.033	NA	3.460	351.0	pCi/g
Sed	SED60092	0.00	1.50	Americium-241	12.250	NA	0.270	76.0	pCi/g
Sed	SED60092	0.00	1.50	Antimony	29.600	NA	13.010	409.0	mg/kg
Sed	SED60092	0.00	1.50	Aroclor-1254	590.000	350.000	NA	12400.0	ug/kg
Sed	SED60092	0.00	1.50	Barium	193.000	NA	188.170	26400.0	mg/kg
Sed	SED60092	0.00	1.50	Cadmium	3.400	NA	1.880	962.0	mg/kg
Sed	SED60092	0.00	1.50	Copper	28.700	NA	27.270	40900.0	mg/kg
Sed	SED60092	0.00	1.50	Fluoranthene	790.000	660.000	NA	27200000.0	ug/kg
Sed	SED60092	0.00	1.50	Mercury	0.360	NA	0.340	25200.0	mg/kg
Sed	SED60092	0.00	1.50	Plutonium-239/240	35.470	NA	1.350	50.0	pCi/g
Sed	SED60092	0.00	1.50	Pyrene	710.000	660.000	NA	22100000.0	ug/kg
Sed	SED60092	0.00	1.50	Toluene	200.000	5.000	NA	31300000.0	ug/kg
Sed	SED60092	0.00	1.50	Zinc	110.000	NA	104.400	307000.0	mg/kg

Figure 2
A-Series Ponds
Sediment and Soil Results Greater than Background Means Plus Two Standard Deviations or RLs/MDLs

KEY

- Result greater than background/RL/MDL and less than WRW AL
- Stream
- Pond

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Scale = 1: 5750

500 0 500 Feet

State Plane Coordinate Projection
Colorado Central Zone
Datum: NAD 27

U.S. Department of Energy
Rocky Flats Environmental Technology Site

Prepared by: RADMS

Date: 3.24.05

Prepared for: KAISER-HILL COMPANY

File: W:\Projects\FY2005\CRA\Ponds\ponds.apr